

Chapter 4

Environmental Impacts of the Two-Year Komeen Trials

Introduction

This chapter describes potential environmental impacts of the Two-Year Komeen Research Trials to resources of the Sacramento-San Joaquin Delta. The chapter is organized in sections corresponding to the sixteen (16) general resource categories identified in the Environmental Checklist, located prior to Chapter 1. Baseline information on these general resources is presented in Chapter 2 (Environmental Setting) and referenced throughout this chapter.

Potential environmental impacts of the EDCP are discussed in Chapter 3. None of the impacts associated with the EDCP are described in this chapter.

Chapter Organization

Each of the chapter's 16 sections contain the following information, unless no project-related impacts are expected to occur:

- ❑ **Introduction:** A brief overview of the discussion focus is presented.
- ❑ **Significance Threshold:** The criteria used to determine whether an impact is above or below a threshold of significance is presented. In some cases, these criteria are quantifiable standards, while in others the criteria are more qualitative.
- ❑ **Environmental Impacts/Consequences:** An assessment of the specific environmental impacts potentially resulting from project operations is presented. The discussion of impacts utilizes findings from the EDCP research trials, technical information from scientific literature on environmental toxicology and ecology, and relevant information on public policies, such as water quality standards. Impact assessments are based on this technical and scientific information.

Where possible, an effort is made to quantify the extent of the impacts, (e.g. persistence of herbicide in the water column over time; approximate percentage of vegetation remaining in treatment area following herbicide application). However, in many instances, it was not possible to quantify the extent of a particular impact accurately. In such cases, the analysis is primarily qualitative.

- ❑ **Significance Determination:** For each impact assessed, a determination is made as to significance level. Potential impacts are categorized as one of the following:
 - *Unavoidable significant impact:* where the environmental effect of the proposed project reaches the threshold of significance but no feasible mitigation is available to reduce the impact to a less-than-significant level. If available, measures are proposed that lessen the significance of the impact.
 - *Unavoidable potentially significant impact:* where available evidence suggests, but is not sufficient to determine conclusively, that a significant impact is unavoidable. If available, measures are proposed that lessen the significance of the impact.
 - *Avoidable significant impact:* where the environmental effect of the proposed project reaches the threshold of significance, but feasible mitigation measures are available to reduce the impact to a less-than-significant level.
 - *Less than significant impact:* where the environmental effect of the proposed project does not reach the threshold of significance. No mitigation is necessary.
 - *No impact:* where the environmental effect of the proposed project would not result in any impact.
- ❑ **Mitigation:** Specific mitigation measures proposed by the DBW to avoid or minimize potential impacts are presented. Mitigation measures refer to measures taken to avoid and/or minimize adverse impacts. The discussion will indicate if no mitigation measures are available.

The DBW has and will continue to undergo consultation with various State and federal agencies, including USFWS, CDFG, NMFS, CVRWQCB regarding impacts and mitigation measures. Proposed mitigation measures may be revised and/or additional mitigation measures incorporated as a result of this consultation process.

Where no impacts are expected to occur to a resource, the section contains a brief statement explaining the basis of this determination.

Overview of Impacts

Exhibit 4-1, on the following page, summarizes impacts of the EDCP at the general resource category level. As shown in **Exhibit 4-2**, following Exhibit 4-1, the EDCP would result in unavoidable significant impacts, or avoidable significant impacts, to the following general resource categories noted below with chapter reference:

- ☐ Hydrology and Water Quality 4.1
- ☐ Biological Resources 4.2
- ☐ Agricultural Resources 4.3
- ☐ Utilities and Public Service Systems 4.4
- ☐ Hazardous and Hazardous Materials 4.5

The EDCP would result in less than significant impacts to the following general resource categories:

- ☐ Transportation and Traffic 4.6
- ☐ Recreation 4.7
- ☐ Air Quality 4.8
- ☐ Mineral Resources 4.9
- ☐ Noise 4.10
- ☐ Geology and Soils 4.11

The EDCP would not impact the following general resource categories:

- ☐ Land Use and Planning 4.12
- ☐ Public Services 4.13
- ☐ Population and Housing 4.14
- ☐ Cultural Resources 4.15
- ☐ Aesthetic 4.16.

EXHIBIT 4-1

Environmental Impacts of the Two-Year Komeen Trials (Listed by General Resource Category)

No.	Resource Categories	Two-Year Komeen Trial Impacts ^a
<i>Potentially Significant Impacts</i>		
1.	Hydrology and Water Quality	USI
	Water Quality	
	Toxicity	USI
	Dissolved Oxygen	LSI
	Sediments	UPSI
	Turbidity	LSI
	Floating Material	LSI
	<i>Water Quality</i>	USI, UPSI
	Drinking Water	
	Chemical Constituents	ASI
	THM Formulation	ASI
	Turbidity	LSI
	<i>Drinking Water</i>	ASI
2.	Biological Resources	USI
	Plants	
	Native Aquatic Plants and Algae	LSI
	Intertidal Wetland Plant Communities	USI
	Terrestrial Plants	NI
	<i>Plants</i>	USI
	Invertebrates	
	Aquatic	USI
	Insects	ASI
	<i>Invertebrates</i>	USI
	Fish	
	Fish	UPSI
	Critical Habitat	LSI
	Prey Base	USI
	<i>Fish</i>	USI, UPSI
	Wildlife	
	Reptiles and Amphibians	USI
	Birds	USI
	Mammals	LSI
	<i>Wildlife</i>	USI
3.	Agricultural Resources	ASI
	Agricultural Operations, Irrigation	ASI
4.	Utilities and Service Systems	ASI
	Public Water Supply Operations	ASI
5.	Hazards and Hazardous Materials	ASI
	Human Health	ASI
	Catastrophic Spills	ASI

No.	Resource Categories	Two-Year Komeen Trial Impacts
<i>Less Than Significant Impacts/No Impacts</i>		
6.	Transportation and Traffic	LSI
7.	Recreation	LSI
8.	Air Quality	LSI
9.	Mineral Resources	LSI
10.	Noise	LSI
11.	Geology and Soils	LSI
12.	Population and Housing	NI
13.	Land Use and Planning	NI
14.	Public Services	NI
15.	Cultural Resources	NI
16.	Aesthetics	NI

Legend

LSI:	Less Than Significant Impact
ASI:	Avoidable Significant Impact
USI:	Unavoidable Significant Impact
UPSI:	Unavoidable Potentially Significant Impact
NI:	No Impact

a) Prior to any proposed mitigation measures.

Environmental Impacts of the Two-Year Komeen Trials (Listed by General Resource Category)

No.	Resource Categories	Impact Significance Prior to Mitigation	Explanation of Impact	Proposed Mitigation Measures	Impact Significance Post Mitigation
1	Hydrology and Water Quality				
	General Water Quality				
	Chemical Constituents	Unavoidable Significant Impact	Komeen use would result in a violation of the Basin Plan standard for copper concentration.	No mitigation available.	Unavoidable Significant Impact
	Toxicity	Unavoidable Significant Impact	Komeen use conflicts with the Basin Plan standards regarding toxicity, which states that Delta waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses.	No mitigation available.	Unavoidable Significant Impact
	Dissolved Oxygen (DO)	Less Than Significant Impact	Komeen use would not likely result in decreases in dissolved oxygen.	Although no mitigation is necessary, standard pre-treatment monitoring would include measuring of DO concentration at treatment sites. If DO concentrations were less than 5 ppm, treatment would be postponed until levels increased above this limit. The DBW would treat no more than 20 acres at a given trial site per day. During late summer and early fall (when DO in the hypolimnion is typically lowest) the DBW would treat no more than 20 acres at a given site over a 14-day period.	Less Than Significant Impact
	Sediments	Unavoidable Potentially Significant Impact	Chelated copper, the active ingredient in Komeen, does not biodegrade and thus could accumulate in the sediments. The extent to which chelated copper might accumulate and the degree of harm it could pose to the aquatic environment is not currently known.	Although the Komeen research trials propose extensive monitoring to determine whether accumulation is occurring, there is no mitigation to avoid this potential impact.	Unavoidable Potentially Significant Impact
	Turbidity	No Impact	Komeen use would not impact turbidity levels.	No mitigation necessary.	No Impact
	Floating Material	No Impact	Komeen use would not increase floating material in the water column.	No mitigation necessary.	No Impact
	Drinking Water				
	Chemical Constituents	Avoidable Significant Impact	Komeen treatments that occur near water treatment facility intakes could adversely impact drinking water supplies if an influx of herbicide-treated water contaminated drinking water supplies.	The DBW would establish a one mile buffer zone around water treatment facility intakes within which <i>no</i> herbicide application would occur without consultation with the water agency. In addition to regular monitoring activities (measurements of DO, herbicide residues, turbidity, etc.) the DBW would coordinate monitoring of BOD, TOC, DOC, and UVA-254 with the DHS.	Less Than Significant Impact
	THM Formulation	Avoidable Significant Impact	Komeen treatments that occur near water treatment facility intakes could increase the potential for THM formation due to the increase in dissolved organic compounds released from decaying plant material.	Same as for Drinking Water Quality - Chemical Constituents above.	Less Than Significant Impact

Environmental Impacts of the Two-Year Komeen Trials (Listed by General Resource Category)

No.	Resource Categories	Impact Significance Prior to Mitigation	Explanation of Impact	Proposed Mitigation Measures	Impact Significance Post Mitigation
	Turbidity	No Impact	Komeen use would not impact turbidity levels.	No mitigation necessary.	No Impact
2	Biological Resources				
	Plants				
	Native Aquatic Plants and Algae	Less Than Significant Impact	Loss of native aquatic plants would be minimal due to the fact that treatment is focused on sites with a high relative abundance (approximately 85 percent) of <i>Egeria</i> . Further, removal of <i>Egeria</i> would create new habitat for native aquatic plants. Algae would not be impacted by Komeen treatments.	No mitigation necessary.	Less Than Significant Impact
	Intertidal Wetland Plant Communities	Unavoidable Significant Impact	Intertidal wetland plants could be adversely impacted or killed due to inundation by Komeen treated water. Special status plants that could be impacted include Mason's lilaeopsis, Delta mudwort, Rose mallow, Delta tule pea, and Northern California black walnut. Wetland plants include tules and cattails.	Prior to Komeen application, channel banks would be surveyed by a qualified biologist to determine whether sensitive plant species are present. If the site exhibits a high percentage of sensitive plants, the site may not be treated. To the degree possible, herbicide applications would occur during low tide to decrease the likelihood that sensitive plants would be inundated by herbicide-treated water. Herbicide application would be focused in the mid-channel region to decrease the possibility that concentrated herbicides would come in contact with sensitive plants growing along channel banks. Following herbicide treatment, channel banks would be surveyed to determine whether a loss of sensitive plants has occurred. If substantial loss is evident, changes may be made to treatment protocol.	Unavoidable Significant Impact
	Terrestrial Plants	No impact	Project operations would not affect plants that occur upland of channel banks.	No mitigation necessary.	No impact
	Invertebrates				
	Aquatic Invertebrates	Unavoidable Significant Impact	Komeen use could cause a temporary decrease in the abundance of aquatic invertebrates, since it is moderately toxic to these organisms. The decrease in invertebrate abundance likely would be temporary. It is expected that planktonic invertebrates would be reintroduced to treatment areas inadvertently through water flow. Further, benthic and plant-dwelling organisms would likely recolonize treatment areas relatively rapidly once regrowth of plants began.	No more than 20 acres would be treated with Komeen at any given site on a given day. Upstream portions would be treated first, and downstream portions would be treated several weeks later. This period of time would likely be sufficient to allow for recolonization of invertebrates.	Unavoidable Significant Impact
	Insects	Avoidable Significant Impact	Komeen use could adversely impact the Valley elderberry longhorn beetle if herbicides inundated valley elderberry shrubs growing on channel banks.	Pre-treatment, surveys would be conducted to determine whether sensitive species are present. Herbicide treatments would not occur along channels where elderberry shrubs could be adversely impacted.	Less Than Significant Impact

Environmental Impacts of the Two-Year Komeen Trials (Listed by General Resource Category)

No.	Resource Categories	Impact Significance Prior to Mitigation	Explanation of Impact	Proposed Mitigation Measures	Impact Significance Post Mitigation
	Fish				
	Fish: Direct Impacts	Unavoidable Potentially Significant Impact	Exposure of fish to Komeen, or its residues, could result in direct adverse impacts to fish. Although Komeen is not expected to be lethal to most fish species, it is moderately toxic to some. Further, Komeen residues could become toxic to certain fish under certain environmental conditions. Finally, Komeen has the potential to bioaccumulate in fish tissues. Special status species that could be impacted include all four runs of chinook salmon, steelhead, Delta smelt, splittail, green sturgeon, longfin smelt, Pacific river lamprey, and river lamprey.	All requirements identified by the regulatory agencies, such as the USFWS, NMFS and CDFG would be adhered to. These could involve, for example, suspension of herbicide trials for specific periods of time to avoid disrupting fish migration or spawning, or avoiding certain habitat conditions. Prior to Komeen application, IEP Real Time Monitoring data would be obtained and evaluated (if available and relevant to the project site) to determine whether any sensitive fish species had been identified in the treatment area. If required, a pretreatment fish survey, following the protocol for pop-net use established by McGowan (1998), would be conducted by a qualified biologist one to two days prior to commencement of each trial. If the number of sensitive fish identified through the IEP data, or pop-net surveys, were above a certain threshold level, the trial would be postponed until additional surveys indicated that fewer sensitive fish were present in the area.	Unavoidable Potentially Significant Impact
	Indirect Impacts to Fish: Habitat	Less Than Significant Impact	Use of Komeen would not likely result in a reduction in DO to concentrations that could adversely impact critical habitat of special status fish species listed above. Loss of native vegetation due to Komeen trials would also be a less than significant impact, since treatments would focus on sites with a high relative abundance of <i>Egeria</i> .	Although no mitigation is necessary for this less than significant impact, standard pre-treatment protocol would include monitoring of dissolved oxygen as described under Drinking Water - Dissolved Oxygen above. No Komeen Trials would occur if DO were found to be less than 5 ppm.	Less Than Significant Impact
	Indirect Impacts to Fish: Prey Base	Unavoidable Significant Impact	Komeen use could cause a temporary decrease in the abundance of invertebrates, which could adversely impact special status fish species such as chinook salmon, delta smelt, and splittail, that consume these invertebrates.	Same as for Biological Resources-- Invertebrates above	Unavoidable Significant Impact
	Wildlife				
	Reptiles and Amphibians	Unavoidable Significant Impact	Komeen use could adversely impact reptiles and amphibians that utilize channels and channel banks in the Delta, including special status species such as the giant garter snake, western pond turtle, and red-legged frog.	Prior to treatment, channel banks and uplands adjacent to treatment sites would be surveyed by a qualified biologist to assess whether sensitive species are present. If evidence suggests a relatively large number of sensitive species are present along channel banks, a new location for the Komeen trials would be selected.	Unavoidable Significant Impact

Environmental Impacts of the Two-Year Komeen Trials (Listed by General Resource Category)

No.	Resource Categories	Impact Significance Prior to Mitigation	Explanation of Impact	Proposed Mitigation Measures	Impact Significance Post Mitigation
	Birds	Unavoidable Significant Impact	Komeen use could adversely impact birds, including special status species such as California black rail and tricolored blackbirds, that nest on channel banks, since the herbicide could kill channel bank vegetation. Further, piscivorous birds could be impacted since Komeen can bioaccumulate in fish tissues.	Same as for Wildlife-Reptiles and Amphibians. Mitigation measures described under Biological Resources– Fish would minimize the possibility that special status bird species would be exposed to Komeen. There is no mitigation to avoid bioaccumulation of Komeen in non-special status bird species.	Unavoidable Significant Impact
	Mammals	Less Than Significant Impacts	Exposure of mammals to Komeen during research trials is expected to be minimal. The only special status mammal species that utilize the sloughs and channels of the Delta are the small-footed myotis bat and Yuma myotis bat, which forage over the water. However, they are not expected to be impacted because Komeen research trials would not affect their insect prey.	No mitigation necessary.	Less Than Significant Impacts
3	Agricultural Resources				
	Agricultural Operations, Irrigation	Avoidable Significant Impact	Komeen use could adversely impact crops if herbicide-treated water were used for irrigation.	Prior to Komeen trials that are to occur near agricultural intakes, the appropriate County Agricultural Commissioner's Office would be consulted. Local landowners could then be informed of the particular periods of time during which irrigation should not occur and when it is safe to begin irrigation. Post-treatment monitoring would include measurement of herbicide residues in the water column.	Less Than Significant Impact
4	Utilities and Service Systems				
	Public Water Supply Operations	Avoidable Significant Impact	An increase in debris load due to decaying plant material following Komeen applications could adversely impact public water supply operations by clogging intake screens and or pumps.	The DBW would establish a one-mile buffer zone around water treatment intake facilities. No herbicide application would occur within that buffer zone without consultation with appropriate water agencies.	Less Than Significant Impact

Environmental Impacts of the Two-Year Komeen Trials (Listed by General Resource Category)

No.	Resource Categories	Impact Significance Prior to Mitigation	Explanation of Impact	Proposed Mitigation Measures	Impact Significance Post Mitigation
5	Hazardous and Hazardous Materials				
	Human Health	Avoidable Significant Impact	Komeen use could adversely impact drinking water supplies as described above under Drinking Water Quality-Chemical Constituents. Consumption of fish or other aquatic organisms recently exposed to Komeen could be harmful to human health. Exposure to concentrated formulations of Komeen could adversely affect human health.	Impacts to drinking water supplies would be avoided through mitigation measures described above under Drinking Water Quality-Chemical Constituents. Prior to treatments, marina and dock owners would be notified regarding timing of the trials. During the trials, sites would be marked with buoys. Additionally, DBW staff would patrol trial sites on a support boat, informing recreators that herbicide application is occurring. Trial sites would be closed to fishing and clamming during and for 48-hours following the trials. Handling of concentrated chemicals would follow protocol identified in "Herbicide Handling Procedures and Spill Contingency Plan" (Appendix S).	Less Than Significant Impact
	Catastrophic Spills	Avoidable Significant Impact	A catastrophic spill of Komeen could result in adverse impacts to aquatic, wetland and intertidal habitat, and associated flora and fauna, including special status species. Adverse impacts to human health could also occur due to exposure to concentrated herbicide formulations. The degree of harm would depend on the amount of chemical spilled, environmental conditions (flow, tidal action), and emergency response time.	Avoidance and mitigation measures are contained in "Herbicide Handling Procedures and Spill Contingency Plan" (Appendix S).	Less Than Significant Impact

4.1 Hydrology and Water Quality

This section assesses potential impacts to Delta water quality resulting from the Two-Year Komeen Trials. Exhibit 4-2 summarizes water quality impacts, proposed mitigation measures, and the significance of the water quality impact both pre- and post-mitigation. Baseline information on Delta water is presented in Section 2.1 of Chapter 2. There are no expected impacts to hydrology from the proposed Two-Year Komeen Trials, thus this section addresses water quality impacts only.

CEQA Guidelines indicate that a project may significantly impact water quality if it:

- ❑ Substantially degrades water quality;
- ❑ Results in a discharge into surface waters or alters surface water quality (e.g., temperature, dissolved oxygen, or turbidity);
- ❑ Conflicts with adopted community goals and environmental plans; or
- ❑ Contaminates a public water supply.

This section is divided into two water quality categories:

- ❑ *General Water Quality* (Section 4.1.1) - impacts to water quality that affect overall ecosystem health, including the potential for Two-Year Komeen Trials to:
 - Contribute toxic constituents to water
 - Reduce dissolved oxygen levels
 - Contribute toxic constituents to sediments
 - Increase turbidity
 - Increase floating material.
- ❑ *Drinking Water Quality* (Section 4.1.2) - impacts to water quality that could affect drinking water supplies, including the potential for Two-Year Komeen Trials to result in the following effects to drinking water supplies:
 - Contribute adverse chemical constituents
 - Increase the potential for trihalomethane (THM) formation
 - Increase turbidity.

(Note that Section 3.1 of Chapter 3 discussed the impact of the EDCP on turbidity and floating material in addition to the parameters just mentioned, due to the potential effect of mechanical harvesting. These parameters are not considered in this chapter, since the Komeen trials would not impact them.)

4.1.1 General Water Quality

Herbicide treatments and mechanical harvesting could potentially impact general water quality at the Two-Year Komeen Research Trials sites. Herbicide treatments could adversely impact general water quality by increasing the concentration of toxic chemical constituents in the water column or sediments, or by reducing dissolved oxygen levels.

4.1.1.1 General Water Quality Significance Threshold

Criteria used to assess general water quality impacts are the water quality standards established and enforced by the Central Valley Regional Water Quality Control Board (CVRWQCB), one of nine regional water quality control boards in California. The CVRWQCB established the Water Quality Control Plan for the Central Valley Region (hereafter referred to as the “Basin Plan”). The Basin Plan sets forth water quality standards (also referred to as “objectives”) that aim to preserve and enhance Sacramento-San Joaquin Delta water quality for the benefit of present and future generations. Basin Plan standards are overseen and enforced by the CVRWQCB.

The following five Basin Plan standards were used to assess general water quality impacts: 1) toxicity in the water column, 2) dissolved oxygen, 3) pesticide concentrations in the sediments, 4) floating material, and 5) turbidity. A description of each of these five standards is provided in **Exhibit 4-3**, on the following page.

4.1.1.2 Environmental Impacts/Consequences to General Water Quality

Under the Two-Year Komeen Research trials, Komeen would be applied to three 50-acre sites twice per year for two years, resulting in treatment of 150 acres each year of the two years. Applications would be made to achieve a water column concentration between 0.75 ppm copper. Approximately 6,075 gallons of Komeen would be applied to the Delta each year, for a two year period.

4.1.1.2.1 Chemical Constituents

Komeen applications at concentrations proposed for the Two-Year Komeen Research Trials would result in a violation of Basin Plan water quality standard for copper (see “Chemical Constituents” in Exhibit 4-3).

EXHIBIT 4-3

Basin Plan Standards

Water Quality Standard	Description of Water Quality Standard
<i>Chemical Constituents</i>	"Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses."
<i>Toxicity</i>	"All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal or aquatic life."
<i>Pesticides^a</i> ^a The document indicates that the term "pesticide" refers to herbicides as well as pesticides.	<p>"Discharges shall not result in pesticide concentrations in bottom sediments...that adversely affect beneficial uses."^b</p> <p>^b There are multiple aspects to this standard, covering impacts to domestic and municipal water supplies as well as aquatic life. These impacts are discussed in other sections of this chapter. The aspect of the pesticide standard introduced here is used to assess impact to sediments.</p>
<i>Dissolved Oxygen</i>	"Within the legal boundaries of the Delta, the dissolved oxygen concentration shall not be reduced below 7.0 mg/l in the Sacramento River...and in all Delta waters west of the Antioch Bridge; 6.0 mg/l in the San Joaquin River...; and 5.0 mg/l in all other Delta waters except for those bodies of water which are constructed for special purposes..."

The DBW proposes to apply Komeen to Trial areas at concentrations between 500 to 750 ppb copper (0.50 to .75 ppm). This would result in at least a temporary exceedence of the copper standard, which specifies a 10 ppb (0.01 ppm) maximum concentration limit for dissolved copper in Central Valley inland surface waters. Input of copper from Komeen applications would be 50 to 75 times higher than this standard.

To assess the magnitude of this impact, it is necessary to consider ambient copper concentration of the Bay/Delta estuary. The following summarizes available data:

- ❑ The Department of Water Resources monitored trace metals at 11 stations in the Delta and Suisun Bay from 1975 to 1993 (DWR 1996). Between 1975 and 1985 copper concentrations exceeded the limit of detection for total and dissolved copper (10 ppb) at least once at each station.
- ❑ San Francisco Estuary Institutes Regional Monitoring Program monitors trace substances at 22 sites in the Estuary three times a year. Results from 1993, 1996, and 1997 indicated that dissolved copper concentrations were between 1.3 to 3.0 ppb near the mouth of the San Joaquin and Sacramento rivers, and Grizzly and Honker bays (SFEI 1993, SFEI 1997, SFEI 1999). Total copper ranged from approximately 1.5 to 11.0 ppb.

While these background levels appear low, they are close to the water quality objectives identified above. Thus, the margin for additional copper inputs to these waters is extremely limited.

Komeen use would result in a violation (however temporary) of the Basin Plan water quality standard for copper. This would be an unavoidable significant impact.

4.1.1.2.2 Toxicity

Komeen application could adversely affect general water quality, since it involves input of a toxic substance (copper) into the water column. It could be viewed as a violation of the Basin Plan standard regarding input of toxic substances to the water column (see “Toxicity” in Exhibit 4-3), and thus is considered an adverse impact.

For a more thorough understanding of the significance of this impact, the toxicity and persistence of Komeen are briefly assessed below.

Characterization of Komeen Toxicity

When applied at label rates, Komeen would be toxic to *Egeria* and other aquatic wetland and terrestrial plants, some fish and aquatic invertebrates. (For a detailed discussion of the toxicity of Komeen and its active ingredient, copper, to biological resources and to human beings, see Sections 4.2 and 4.5, respectively).

Persistence of Komeen in the Water Column

Evidence indicates that application of Komeen would only result in a temporary increase in copper concentration to the water column. Rapid uptake by plants, as well as dilution, binding and export, lead to the rapid decrease in copper concentrations in the water column following Komeen application (Anderson, pers. comm., 1998). The following summarizes findings from research trials conducted at three Delta sites (White Slough, Seven Mile Slough, and Sandmound Slough) by Anderson (1998) during June and August 1998:

- ❑ The target water column concentration for the research trials was 0.75 ppm copper. Water column copper concentrations near the treatment site three hours following application were generally between 0.50 and 1.50 ppm within the three to five acre plots.
- ❑ Tidal action tended to mix the water vertically, so that by the second tidal movement (approximately 9 hours later), copper was relatively uniformly distributed in the water column.
- ❑ Applications resulted in copper concentrations in *Egeria* tissues that have been shown to produce defoliation and necrosis in previous studies.
- ❑ By 24 hours post-treatment, copper had declined to baseline or near-baseline concentrations at all stations.

Similar studies have been conducted at Clear Lake, California, as part of the environmental monitoring for the *Hydrilla verticillata* eradication efforts, which have been conducted at this lake since 1994 (Trumbo 1997, Trumbo 1998). The dissipation rate is faster at the Delta treatment sites than in Clear Lake. This is expected since the Delta is a flowing rather than standing water system. The following summarizes findings from Komeen trials at Clear Lake conducted by Trumbo (1997, 1998):

- ❑ During Komeen treatment at Clear Lake in 1996, mean copper concentrations detected in water samples taken from treatment sites at three lake depths (surface, mid-depth and bottom) four to six hours post-treatment varied from 3.7 to 1,967 ppb (Trumbo 1997). The mean concentration for these samples was 445.2 ppb.

- ❑ Two days post treatment, copper concentrations were detected in a range from 3.0 to 423.7 ppb, with a mean of 73.7 ppb.
- ❑ Four days post treatment, copper concentrations declined further to near background levels (2 ppb), with a mean of 13.6 ppb copper.
- ❑ Eight days following treatment, copper concentrations were generally between 2 and 16 ppb.
- ❑ Results from the 1997 monitoring program were very similar to the results obtained in 1996, in that concentrations again dissipated to near background concentrations within eight days post-treatment (Trumbo 1998). (No sampling was conducted on days 2 and 4 as was done during the 1996 monitoring.)
- ❑ According to Trumbo (1997), these data indicate the elevated copper concentrations measured at Komeen treatment sites were transitory in nature. Dissipation occurred through various mechanisms including dilution into surrounding waters by lake currents (Trumbo 1997).

These studies indicate that increases in copper concentrations following Komeen application would be a temporary. Thus, the exceedence of water quality standards identified in the Basin Plan would be short lived. Further, since dissipation occurs rapidly, it is unlikely that treatments in the Delta would contribute to any notable increases in water column copper concentrations in San Francisco Bay.

In conclusion, Komeen application would result in unavoidable significant impacts to general water quality, due to the toxicity of the herbicide.

4.1.1.2.3

Pesticide Residues

The potential exists for Komeen and/or its active ingredient, chelated copper, to accumulate and persist in the sediments in a way that could adversely impact beneficial uses. Thus application could potentially violate the Basin Plan standards regarding pesticide residues in the sediments (see “Pesticides” in Exhibit 4-3).

The potential for copper accumulation in the sediments to occur following Komeen application is under debate. Areas of current understanding and controversy are presented below.

Uncertainty Regarding Fate of Copper in the Aquatic Environment

Despite the fact that copper from herbicide treatments may be short-lived in the water column, it eventually ends up in the sediments and does not degrade (Leslie 1992). Depending on the biological availability of the copper compound, adverse impacts to beneficial uses could result from such accumulation.

The primary aim of the Two-Year Komeen Research Trials is to determine whether the accumulation of Komeen in the sediments would result in a significant adverse impact to the aquatic environment. Previous field trials using Komeen were inconclusive in their findings regarding the fate of copper introduced to the aquatic environment through application of Komeen. Methods and findings from the 1998 Komeen Research Trials (Huang and Guy 1998) are summarized below.

- ❑ Sediment samples were taken prior to and following Komeen application at the three treatment sites in the Delta (White Slough, Seven Mile Slough, and Sandmound Slough) (Huang and Guy 1998). Fifty-seven sediment samples were collected.
- ❑ Control plot samples contained copper residues in a range from 32 µg/g to 62 µg/g. There was very little variation in sediment copper concentrations at the control sites from June to September.
- ❑ Copper concentrations in samples collected at Komeen treatment plots 30 days post-treatment were in a range from the detection limit of 9 µg/g to 102 µg/g. When the final samples were taken 30 and 60 days post-treatment, copper concentrations for all plots were at, or even lower than, the concentrations detected in samples collected before the first 1998 herbicide treatments. There was no significant difference in copper concentrations between pre-treatment and post-treatment plots treated with Komeen.
- ❑ The maximum copper residue found in sediment was 102 mg/g (dry wt.). This is approximately one-third of the reported effect range-median (ER-M) value of 390 mg/g for copper (Long and Morgan, 1991). The ER-M is the concentration of a metal in sediment at which biological effects are frequently observed or predicted for most species (Kemble and others 1994).
- ❑ Huang and Guy (1998) stated that no definitive conclusions regarding copper accumulation in the sediments could be reached using these data. They recommended that additional tests be conducted to examine sediment toxicity, and biological availability of copper at treatment sites if monitoring revealed an increase in sediment copper.

Potential Problems Regarding Interpretation of Study Results

While these tests did not show any increases in concentration of copper in the sediments, they also did not point to any definite conclusions regarding the potential for copper accumulation in the sediments. Further, the finding of "no significant difference" between copper concentrations at the control and treatment areas may simply reflect the fact that a substantial copper burden already exists in the sediments which is highly variable spatially. Copper input to the sediments from these trials may not have been substantial enough to constitute a statistically significant difference, given the high variability of copper concentration in the sediment.

It has also been suggested (Peterson, pers. comm., 1999) that no significant difference was detected between concentrations at control and treatment sites due to a flaw in the sampling design. Huang and Guy (1998) collected core samples that were 15 cm deep, despite the fact that residue from the herbicide treatment would be expected to occur in a thin band at the surface of the sediments. Any copper residues that had been deposited at the sediment surface could have been diluted in this larger 15 cm sample. Problems could also have arisen due to incomplete mixing of this large sample size.

Conclusions to Date

Huang and Guys' findings concerning the accumulation of copper in the sediments are somewhat inconclusive. A conservative conclusion is that the potential exists for adverse impacts to result from use of Komeen, due to the potential accumulation of copper in the sediments. Resolving this controversy is the primary purpose of the Two-Year Komeen Research Trials.

In conclusion, Komeen and/or copper could potentially persist in the sediments in such a way as to adversely affect the aquatic environment. More information is necessary to determine conclusively whether this impact is significant. Thus, Komeen application is viewed as an unavoidable potentially significant impact to general water quality, due to the potential affect of the herbicide on Delta sediments.

4.1.1.2.4

Dissolved Oxygen

Komeen use is not expected to result in decreased dissolved oxygen, and thus is not expected to violate the Basin Plan standards regarding dissolved oxygen (see "Dissolved Oxygen" under Exhibit 4-3).

Although Komeen is a fast-acting herbicide, and thus could potentially cause a rapid decrease in dissolved oxygen due to the decomposition of organic matter, data suggest that Komeen does not cause such decreases. Anderson (pers. comm. 1999) did not detect any change in dissolved oxygen following Komeen application at Del's Harbor in the South Delta during USDA field trials conducted in 1999. Pretreatment dissolved oxygen concentrations taken in April and May ranged from approximately 6.0 to 7.5 mg/l, while post-treatment concentration taken in June ranged from approximately 5.8 to 7.8 mg/l. Likewise, following Komeen treatment by the Department of Water Resources at Clifton Court Forebay in the Delta during May 1995, dissolved oxygen concentration remained high, at values greater than 90 percent saturation (DWR, 1995). These data suggest that decreases in dissolved oxygen following Komeen application are unlikely to occur, at least during the spring and early summer period.

In conclusion, Komeen use would result in less than significant impacts to general water quality, with respect to the herbicide's effect on dissolved oxygen.

4.1.2

Drinking Water Quality

Adverse impacts to drinking water quality could potentially occur if herbicides were used in the vicinity of any water treatment plant intakes for local or regional drinking water utilities. The Contra Costa Water District (District) diverts water for drinking water use at three Delta intakes: Rock Slough, Old River south of Highway 4 Crossing, and Mallard Slough. There also are several other districts that may draw water from the Delta. Thus, the possibility exists that the Komeen Trials could degrade drinking water quality. For example, drinking water could be adversely impacted if herbicide-treated water were diverted into drinking water supplies. This could result in adverse impacts to health (discussed further under Section 4.5.2.1.2).

Additionally, use of these herbicides in the vicinity of water treatment plant intakes could increase the potential for trihalomethane formation in drinking water supplies. Trihalomethanes are suspected carcinogens that can form during the water treatment process. Herbicide treatments that occur in the vicinity of water treatment plant intakes can facilitate the production of trihalomethanes, by providing a source of dissolved organic compounds (i.e. decaying plant material). When these dissolved organic compounds, (also referred to as "trihalomethane precursors") react with the chlorine that is used for disinfection during the water treatment process, trihalomethanes are produced. National Primary Drinking Water Regulations include standards (MCLs) for trihalomethanes.

4.1.2.1

Drinking Water Quality Significance Threshold

Criteria used to assess impacts to drinking water quality are the National Primary and Secondary Drinking Water Regulations, established by the U.S. Environmental Protection Agency (USEPA) and enforced by the California Department of Health Services (DHS). The DHS is designated by the USEPA as the primary agency in California to administer and enforce requirements of the federal Safe Drinking Water Act (SWDA).

The SDWA, established in 1974, requires the USEPA to regulate contaminants that present health risks and are known or are likely to occur in public drinking water supplies (USEPA, 1999). USEPA fulfills this requirement by establishing and overseeing a set of drinking water standards referred to collectively as the National Primary and Secondary Drinking Water Regulations.

For each contaminant requiring federal regulation, the USEPA has set a non-enforceable health goal referred to as a “maximum contaminant level goal” (MCLG). The MCLG is the level of a drinking water contaminant below which there is no known or expected risk to health.

The USEPA also is required to establish an enforceable drinking water standard as close to the MCLG as is technologically feasible, taking cost into consideration. This enforceable standard is the “maximum contaminant level” (MCL). An MCL is the maximum permissible contaminant level in water delivered to any user of a public water system. Violation of an MCL indicates a potential immediate or long-term health risk.

MCLs form the basis of both the National Primary and Secondary Drinking Water Regulations as described below:

- ❑ Primary Drinking Water Regulations - MCLs are established for a number of chemical and radioactive contaminants, and are found in Title 22 California Code of Regulations (CCR). They include inorganic chemicals (64431), trihalomethanes (64439), radioactivity (64441 and 64443), organic chemicals (64444), and lead and copper (64670).
- ❑ Secondary Drinking Water Regulations - MCLs are established for a number of chemicals or characteristics. They are set for taste, odor, or drinking water appearance and are found in Title 22 CCR, 64449.

4.1.2.2 Environmental Impacts/Consequences to Drinking Water Quality

This section is organized into the following subsections:

- 4.1.2.2.1 Unwanted Chemical Constituents
- 4.1.2.2.2 Potential for Trihalomethane Formation.

4.1.2.2.1 Unwanted Chemical Constituents

Komeen use could increase the water column concentration of copper, the active ingredient in Komeen, up or close to the maximum contaminant level (MCL) established for concentration of this chemical in drinking water. The primary MCL for copper is 1.3 ppm. Drinking water supplies containing concentration of copper above this 1.3 ppm threshold are considered to present a health risk (USEPA). The target water column concentration for Komeen under the two-year trials is 0.75 to 1.0 ppm, which is only slightly below the enforceable limit for copper in drinking water. Thus, if water treated with Komeen were diverted for drinking use, drinking water quality could be adversely impacted.

However, as currently proposed, Komeen research trial sites are not in the vicinity of any intake facilities. No impacts would occur unless a change were made in the location of these trial sites. Such a change would have to be approved by the appropriate regulatory agencies.

In conclusion, Komeen application could result in an avoidable significant impact to drinking water quality if trials occurred in the vicinity of an intake facility, due to the input of copper to the water column.

4.1.2.2.2 Potential for Trihalomethane Formation

Komeen use could increase the potential for trihalomethane formation when used in the vicinity of water treatment plants. The MCL for total trihalomethanes is 0.1 ppm. It is not known how much herbicide treatments could increase the potential for trihalomethane formation. However, the Komeen research trials could result in adverse impacts to drinking water supplies if a substantial quantity of dissolved organic material from the decaying plants were present in water diverted for drinking use.

Komeen use could adversely impact public water supplies if treatments occurred in the vicinity of an intake facility, by increasing the potential for trihalomethane formation. This would be an avoidable significant impact.

4.1.3 Significance Determination for Water Quality

The Two-Year Komeen Research Trials would result in unavoidable, avoidable, and less than significant impacts to water quality, as described below. Approximately 150 acres would be directly affected each year by any given impact to general water quality, unless the proposed mitigation measures were implemented. Acreage affected by impacts to drinking water would depend on the proximity of the Komeen trial sites to intake facilities.

4.1.3.1 General Water Quality

Unavoidable Significant Impacts

- ☐ Unavoidable significant impact due to violation of Basin Plan standard regulating water column copper concentration. Mitigation measures are proposed to minimize this impact to the extent possible.
- ☐ Unavoidable significant impact due to toxicity of Komeen. Mitigation measures are proposed to minimize this impact to the extent possible.
- ☐ Unavoidable potentially significant impact to sediments due to the potential for Komeen or copper residue accumulation. Mitigation measures are proposed to minimize this impact to the extent possible.

Avoidable Significant Impacts

- ☐ None.

Less Than Significant Impacts

- ☐ Less than significant impact to dissolved oxygen due to Komeen use.

4.1.3.2 Drinking Water Quality

Unavoidable Significant Impacts

- ☐ None.

Avoidable Significant Impacts

- ☐ Avoidable significant impact due to the potential influx of copper into water treatment plant intake facilities. Mitigation measures are available to avoid this impact.

- ❑ Avoidable significant impact due to the potential for an increase in trihalomethane formation. Mitigation measures are available to avoid this impact.

Less Than Significant Impacts

- ❑ None.

4.1.4 Mitigation Measures for Impacts to Water Quality

4.1.4.1 General Water Quality

*Mitigation Measures to Avoid or Minimize
Impacts to General Water Quality*

Despite the fact that Komeen application would result in less than significant impacts to dissolved oxygen, the following measures would be taken to ensure that impacts to dissolved oxygen do not occur.

- ❑ Prior to any herbicide trial, the DBW would measure dissolved oxygen throughout the water column. If dissolved oxygen concentrations in the hypolimnion were less than 5 ppm, the DBW would postpone trials until levels are above this limit.
- ❑ Maximum Treatment Acreage - The DBW would treat no more than 20 acres at a given trial site per day. During late summer and early fall (when dissolved oxygen in the hypolimnion is typically lowest), the DBW would treat no more than 20 acres at a given site over a 14-day period.

4.1.4.2 Drinking Water Quality

*Mitigation Measures to Avoid or Minimize
Impacts to Drinking Water Quality*

Measurements to avoid and minimize significant impacts to drinking water quality include:

- ❑ Agency Notification - The DBW would contact appropriate drinking water utilities, as well as the Department of Health Services Drinking Water Program, to indicate that a trial is to occur. This would occur at least two weeks prior to commencement of trial.
- ❑ Buffer Zones - To avoid drinking water quality impacts (e.g., influx of copper and increase in trihalomethane formation potential), a one-mile buffer zone would be established around water treatment plant intakes. No trials would occur within this buffer zone

without consultation with appropriate public water agencies. The DBW would coordinate with the appropriate public water agencies to establish these buffer zones. Minimization and avoidance measures for any Komeen trial that is to occur within a certain number of miles of a public water intake (distance as yet to be determined) would include the following:

- Pre- and Post-Treatment Sampling - In addition to standard pre- and post-treatment sampling (dissolved oxygen, herbicide residue concentration, sediment sampling), if required, the DBW would coordinate sampling for biochemical oxygen demand (BOD), total organic carbon (TOC), dissolved organic carbon (DOC), and UVA-254. This sampling effort would be carefully coordinated with the appropriate public water agencies. Data would be shared with interested agencies. If any of these measurements exceeded Primary or Secondary Drinking Water Standards (or any other standard applicable to water diverted for drinking supplies) prior to a scheduled treatment, the treatments would be postponed until conditions were such that drinking water quality would not be compromised by Komeen Trial activities. If post-treatment sampling indicated violations of any standards, changes to the trial protocol would be made to avoid future impacts.
- Treatments at adequate intervals to avoid an excess of decaying plant (THM precursors) near water treatment facilities.

4.2

Biological Resources

This section assesses potential impacts to biological resources resulting from the Two-Year Komeen Research Trials. The discussion focuses on the effects of the trials on abundance, distribution, and health of the aquatic and terrestrial plants and animals that reside or migrate through the Delta. Effects of project activities on threatened, endangered, and other special status species are discussed. Further, effects of Two-Year Komeen Trial activities to habitat are examined.

This section is organized as follows:

4.2.2 Plants

4.2.2.1 Native aquatic plants and algae

4.2.2.2 Intertidal wetland plants communities

4.2.2.3 Terrestrial plants

4.2.3 Invertebrates

4.2.3.1 Aquatic invertebrates

4.2.3.2 Insects

4.2.4 Fish

4.2.4.1-.2 Direct impacts to fish

4.2.4.3-.4 Indirect impacts to fish

4.2.5 Wildlife

4.2.5.1 Reptiles and amphibians

4.2.5.2 Birds

4.2.5.3 Mammals

Potential impacts of Two-Year Komeen Trials are assessed. Results from the scientific field trials, as well as findings from primary and secondary scientific literature are presented and discussed.

Baseline information on biological resources in the Delta is presented in Section 2.2 of Chapter 2. Section 2.2 includes life histories of threatened, endangered, and special status species in the Delta that could be present in the project area (i.e., channels, sloughs, channel banks and uplands adjacent to channels of the Delta).

Exhibit R-1 in Appendix R lists all special status species found in the Delta and Suisun Marsh and indicates which species could be impacted by the project. It is assumed that species would not be impacted by the proposed project if they do not 1) occur in the Delta, or 2) occur in or utilize (nest,

stage, migrate through, spawn, breed, forage) habitats potentially impacted by the Two-Year Komeen Trials (Delta channels, sloughs, channel banks, and upland areas immediately adjacent to channel banks.)

4.2.1 Biological Resources Significance Threshold

Impacts to plants, invertebrates, fish, and wildlife populations are significant when project operations cause or contribute to substantial short or long-term reductions in abundance and distribution. A biological effect is significant based on CEQA Guidelines if it:

- ☐ Substantially affects a rare or endangered species of animal or plant or the habitat of the species;
- ☐ Interferes substantially with the movement of any resident or migratory fish or wildlife species;
- ☐ Substantially degrades water quality (thus adversely affecting species dependent on the water source); or
- ☐ Substantially diminishes habitat for fish, wildlife or plants.

Populations of plants, aquatic invertebrates, fish, and wildlife species may be reduced because of increases in mortality and changes in habitat availability that affect species survival, growth, migration, and reproduction.

4.2.2 Plants

4.2.2.1 Native Aquatic Plants and Algae

In the Delta, the vigorous growth of *Egeria* has resulted in nearly monospecific beds of this invasive species. Grimaldo and Hymanson (1999) found *Egeria* to be the dominant submergent vegetation type in shallow water areas of the central Delta. The relative abundance of native aquatic plants in *Egeria* beds typically is low, due to the competitive dominance of this species. For this reason, a relatively small percentage of native aquatic vegetation would be subject to herbicide or mechanical harvesting treatments. However, although the project operations would target *Egeria*, native aquatic plants and algal species that grow in beds of *Egeria* would be affected to some extent.

Table 4-1 lists common native aquatic plants that occur in the Delta. No special status aquatic plants occur in the Delta.

Table 4-1

Scientific Name	Common Name
<i>Ceratophyllum demersum</i>	Hornwort
<i>Ranunculus aquatilis</i>	Aquatic buttercup
<i>Potamogeton nodosus</i>	Long-leaved pondweed
<i>Potamogeton pectinatus</i>	Fennel-leaved pondweed
<i>Ruppia cirrhosa</i>	Ditch-grass
<i>Lemna</i> sp.	Duckweed
<i>Azolla filiculoides</i>	Mosquito fern
<i>Ludwigia peploides</i> ssp. <i>Peploides</i>	Water primrose

To minimize adverse impacts to native aquatic plants, the DBW selected trial sites where aerial photography indicated that estimated *Egeria* abundance was at least 85 percent. To minimize future losses to native vegetation, the DBW would not treat a site where the percent of total vegetation is less than 65 percent *Egeria*.

Egeria abundance at proposed treatment or trial sites could change over the course of the program. If future aerial photography indicates trial sites have less than 65 percent of *Egeria*, the DBW would consult with appropriate regulatory agencies to determine whether changes to the Komeen trials should occur.

The extent of impacts to native aquatic plants and algae from the trials depends upon herbicide selectivity and efficacy, as well as the efficacy of mechanical harvesting.

Komeen Application

Successful applications of Komeen could result in semi-permanent removal of *Egeria* from trial sites. Since Komeen is a non-selective herbicide, native plants within and adjacent to the treatment areas may be killed. Further, Komeen is expected to result in approximately 70 percent efficacy over the two-year research period, which is relatively high.

However, the acreage treated with Komeen each year of the Two-Year Research Trials is 150 acres, which is just 0.3 percent of the 50,000 total water body

surface acres of the Delta. Further, as indicated above, the DBW would only apply Komeen to sites at which the relative abundance of *Egeria* was 65 percent or higher. Thus, the loss of native vegetation would be minimized. Komeen application also would not impact algae, since Komeen is not an algaecide. Finally, native plant abundance in the Delta would likely increase as removal of dense beds of *Egeria* opened available substrate for growth. In conclusion, impacts to native aquatic plants and algae due to use of Komeen would be less than significant.

4.2.2.2

Intertidal Wetland Plants

Impacts of the Two-Year Komeen Trials to wetland habitat are considered significant under CEQA. The Two-Year Komeen Trials could potentially result in impacts to intertidal wetland plant communities that occur along Delta channels and on in-channel islands. These communities are loosely divided into the following three categories: 1) herbaceous intertidal, including special status plants such as Mason's lilaeopsis (*Lilaeopsis masonii*), Delta mudwort (*Limosella subulata* Ives.), rose mallow (*Hibiscus lasiocarpus*), Delta tule pea (*Lathyrus jepsonii* Greene ssp. *Jepsonii*), as well as rushes and sedges; 2) riparian, including the sensitive Northern California black walnut (*Juglans californicus dimorphus*), as well as willows and cottonwoods; and 3) marsh, including tules and cattails.

These intertidal wetland plant communities could be adversely impacted by wave-wash or flooding during high tide if herbicide concentrations in the channel water are at treatment levels. Loss of sensitive plant species in these communities would constitute a significant impact, and could result in additional adverse effects, such as increases in erosion and corresponding decreases in water quality. Loss of intertidal wetland vegetation could also impact sensitive wildlife species that may use these environments for nesting, cover and forage. (This impact will be discussed below under Section 4.2.5 Wildlife). Additional impacts could occur to these sensitive plant communities due to mechanical harvesting. Neither the extent of acreage potentially impacted nor the intensity of the impact is known.

The potential effects of each of the Two-Year Komeen Trials on intertidal wetland plants are discussed below.

Komeen Application

Komeen applications in areas near intertidal wetland plant communities could result in loss of plants or local plant populations. Since Komeen is a contact herbicide, impacts could occur due to wave wash or inundation during high

tide. Treatments could result in all impacts discussed above. However, since Komeen is a contact herbicide, there is a greater likelihood that existing populations would not be permanently lost.

In conclusion, application of Komeen would result in unavoidable significant impacts to intertidal wetland plants, including special status species.

4.2.2.3 Terrestrial Plants

The Two-Year Komeen Research Trials would not impact upland terrestrial plant species because trials would occur in the water column. No herbicides would come in contact with terrestrial plant species.

4.2.3 Invertebrates

4.2.3.1 Aquatic Invertebrates

The Two-Year Komeen Trials could temporarily decrease aquatic invertebrate abundance in and around treatment sites. Invertebrates could be killed by herbicides or physically removed and destroyed by mechanical harvesting. Loss of invertebrates, such as zooplankton, could also indirectly impact fish that prey upon these organisms. (This impact will be discussed in more detail under Section 4.2.4.)

However, though decreases in invertebrate abundance could occur, they would likely be temporary. Planktonic (floating) invertebrates, such as zooplankton and shrimp, would be reintroduced to treatment areas inadvertently through water flow. Further, benthic (bottom dwelling) organisms and plant-dwelling organisms would likely recolonize treatment areas rapidly once regrowth of plant material began.

No special status aquatic invertebrates occur in the Delta. The remainder of this section describes invertebrate community composition in beds of *Egeria*, and assesses potential impacts to the species present.

Aquatic Invertebrates Commonly Found in Beds of Egeria

Obrebski and others (1998) studied community composition of invertebrates found in *Egeria* beds at several locations in the Delta: Venice Island, Franks Tract, Big Break, Seven Mile Slough and Sandmound Slough. **Exhibit 4-4**, on the following page, lists the aquatic invertebrates found in association with *Egeria* during this study.

EXHIBIT 4-4

Aquatic Invertebrates

Phylum	Class	Order	Family	Genus
Coelenterata				<i>Hydra</i>
Platyhelminthes				<i>Dugesia</i>
Nemertea				<i>Prostoma</i>
Bryozoa				<i>Plumatella</i>
Mollusca			Physidae	<i>Physa</i>
			Planorbidae	<i>Gyraulus</i>
			Ancylidae	<i>Ferrisia</i>
Annelida	Oligochaeta		Naididae	<i>Stylaria</i>
				<i>Chaetogaster</i>
			Tubificidae	<i>Tubifex</i>
			Hirundinea	<i>Helobdella stagnalis</i>
				<i>Helobdella fusca</i>
Arthropoda	Crustacea	Amphipoda		<i>Hyalella azteca</i>
				<i>Corophium</i>
		Ostracoda		
		Copepoda		
		Cladocera		
			Moinidae	
				<i>Moinodaphnia</i>
			Sididae	
				<i>Sida</i>
			Chydoridae	
				<i>Eurycercus</i>
				<i>Pseudochydorus</i>
Insecta		Odonata	Zygoptera	
		Tricoptera		
		Diptera		
			Culicoidea	
Arachnida		Hydracarina		

None of the species or taxonomic groups identified in the samples are identified as special status species. Obrebski and others (1998) assert that the community composition observed is characteristic of freshwater attached macrophytes in the continental United States. The five most common taxa were:

- ❑ Dipteran larvae
- ❑ the amphipod *Hyaella azteca*,
- ❑ Cladocera
- ❑ the snails *Physa sp.*, and *Gyraulus sp.*
- ❑ the oligochaete *Stylaria*.

Several of these invertebrates, in particular crustaceans including copepods and dipterans, are consumed by special status fish species such splittail, juvenile chinook salmon, and delta smelt (Moyle 1976, Wang 1986, and Herbold 1987).

Komeen Application

Komeen application could result in a decrease in invertebrate prey abundance in and around treatment locations. Under the Two-Year Komeen Research Trials, Komeen would be applied to achieve a water column concentration of 0.75 ppm. At these concentrations, Komeen would likely be lethal to certain aquatic invertebrates. The response of various invertebrates to Komeen is shown in **Table 4-2**, on the following page. The following summarizes research findings on the toxicity of Komeen to aquatic invertebrates:

- ❑ In Komeen toxicity tests using Clear Lake water, Trumbo (1997) found the 96-hour LC₅₀¹ value for the cladoceran *Ceriodaphnia dubia* to be 0.11 ppm. In additional tests using Clear Lake water, the LC₅₀ value for the amphipod, *Hyaella azteca*, was 1.3 ppm, for the crayfish *Procambrus clarkii*, 31.8 ppm, and for the snail, *Physa sp.*, 0.64 ppm (Trumbo 1998).
- ❑ Mayer and Ellersick (1986) reported that the 96-h LC₅₀ values for apple snail *Pomacea sp.* exposed to Komeen was 0.52 ppm.
- ❑ Impacts to cladoceran species due to Komeen appear to be well-established. Under contract with the DBW, Huang and Guy (1998) conducted Komeen toxicity tests using cladoceran *Ceriodaphnia dubia* neonates (less than 24 hours old). The organisms were exposed to undiluted water samples in 96-hour static tests with renewal at 48 hours. Mortality and water quality characteristics were recorded daily. Tests performed with water samples collected prior to Komeen treatment and from the negative control site produced no significant mortality in *C. dubia*.

1 Lethal Concentration 50, or LC₅₀, is the concentration of toxicant necessary to kill 50 percent of the organisms being tested. It is usually expressed in parts per million (ppm). Length of the test (in hours) is also typically indicated.

- ❑ Overall, water samples collected at treatment sites 3 hours post-treatment were very toxic to *C. dubia*. Complete mortality (survival of 0 percent) of the test organisms generally occurred in the undiluted water samples from treatment plots. Water samples with significant mortality contained copper concentrations in a range of 0.15 to 0.80 ppm. These copper levels were consistently higher than the 96-hour LC₅₀ value for cladocerans of 0.11 ppm (as Cu) (Trumbo, 1997).
- ❑ The toxicity caused by Komeen generally dissipated within 24 hours. Test performed on water samples taken 24 hours post-treatment produced 80 to 100 percent survival. There was less significant cladoceran mortality because copper concentrations by 24 hours post-treatment had dissipated to 100 ppb or less, a concentration range that would not be expected to produce mortality.

Table 4-2

Response of Various Invertebrates to Varying Concentrations of Komeen

Organism	LC ₅₀ Value (ppm)	Comments	Reference
<i>Ceriodaphnia dubia</i> (Cladoceran)	0.11	96-hour test	Trumbo 1997
<i>Hyaella azteca</i> (amphipod)	>1.27	96-hour test	Trumbo 1997
<i>Procambrus clarkii</i> (crayfish)	31.8	96-hour test	Trumbo 1997
<i>Physa</i> sp. (snail)	0.64	96-hour test	Trumbo 1997
<i>Ceriodaphnia dubia</i> <i>neonates</i>	Not Applicable	Significant Mortality when exposed to 0.15-0.80 ppm	Huang and Guy 1998

Komeen application during the two-year field trials would likely result in mortality to aquatic invertebrates of various species. The efficacy of Komeen application is expected to be relatively high, approximately 70 percent, thus only 30 percent of the *Egeria* growing at each 50-acre plot is expected to remain following treatment. With a relatively low percentage of vegetation remaining, recolonization by aquatic plant-dwelling invertebrates may take a relatively longer period of time. As mentioned previously, planktonic invertebrates would likely be reintroduced to the site relatively quickly. In conclusion, the decrease in aquatic invertebrate abundance due to use of Komeen would be a short-term unavoidable significant impact.

4.2.3.2**Insects**

The Two-Year Komeen Research Trials could adversely affect elderberry, which are protected as habitat for the Federally threatened valley elderberry longhorn beetle. Valley elderberry longhorn beetles are strictly tied to their host plant, and are thus adversely impacted by harm to the shrub.

No other special status insect species occur in the project area.

Impacts to non-listed species are expected to be less than significant. Komeen applications may kill some insect larvae that occur in the water. However, insect loss would be less than significant, since the total acreage affected by Research Trials is minimal compared to the area in which insect larvae can develop in the Delta.

Komeen Application

Komeen application could adversely affect valley elderberry longhorn beetle, by impacting elderberry that grow on channel banks. Elderberry could suffer damage if herbicide-treated water inundated areas where elderberry were present. In conclusion, Komeen use could result in avoidable significant impacts to valley elderberry longhorn beetle.

4.2.4**Fish***Use of Egeria Beds by Fish*

Shallow vegetated areas function as nurseries for small fish, providing relatively abundant food and shelter from predators. Some native fish of the Delta, including the threatened splittail and delta smelt, are known to use aquatic vegetation for spawning and rearing (McGowan 1998). Likewise, juvenile salmon may use shallow water during their migrations through the Delta.

However, use of dense aquatic vegetation, such as *Egeria*, by fish is not well documented. Although some studies report that dense beds of *Egeria* provide habitat for certain fish, other studies suggest that depressed oxygen levels and reduced temperatures characteristic of beds are limiting to certain species (Cook and Urmi-Konig 1984).

Researchers at San Francisco State University, under contract with the DBW, studied the use of *Egeria* beds by delta smelt, splittail, migratory salmonids, and other fish of the Sacramento-San Joaquin Estuary (McGowan 1998, and McGowan and March 1998). Pop nets and light traps were used to collect fish in *Egeria* beds. Additionally, piles of *Egeria* mechanically harvested

during other DBW experiments were sampled and sorted in their entirety for fish and invertebrates. (See McGowan 1998 for an explanation of sampling methods.) Samples were collected from May through late October at six sites in the Delta: Sandmound Slough, Seven Mile Slough, White Slough, Big Break Marina, Frank's Tract, and Little Venice Island. A total of 257 pop-net samples and 193 light trap samples were collected over the sampling period. In the pop-net samples, 2,181 individual fish were collected; 840 fish were collected in the light traps, and 671 fish, crabs, and tadpoles were sorted from the harvested *Egeria*.

A total of fourteen (14) species of fish were collected from the sampling effort as shown in **Table 4-3**, on the following page. Of the fourteen species of fish collected, only one is a native species (prickly sculpin). According to McGowan (1998), species collected were typical non-native residents of the Delta. Small individuals of bluegill, sunfish, largemouth bass, threadfin shad, and inland silversides dominated the catches. No sensitive species such as delta smelt, splittail, juvenile chinook, or steelhead were collected. These data should provide a fairly accurate indication of which fish species may be found in *Egeria* beds during the Komeen Research Trials, since the sampling was conducted during many of the same months that project operations would occur.

McGowan's findings are similar to those of the Grimaldo and Hymanson (1999), who report that introduced fish species and Chinese mitten crabs were most abundant in *Egeria* stands in the Delta, as opposed to other submerged macrophyte habitat types. Further, these researchers found that native fish were far less frequent inhabitants of the *Egeria* beds. The findings of McGowan (1998) and Grimaldo and Hymanson (1999) suggest that *Egeria* is not typically used by native fish species or specifically any threatened, endangered, or special status species as habitat or as a migration corridor.

Table 4-3

Fish Collected in *Egeria* Beds Within the Delta
(McGowan, 1998)

Species	Big Break	Frank's Tract	Little Venice	Seven Mile Slough	Sandmound Slough	White Slough
Blue gill	X	X	X	X	X	X
Redear			X	X	X	X
Largemouth bass	X	X	X	X	X	X
Black crappie				X	X	X
Warmouth				X	X	X
Golden shiner					X	
Red shiner	X			X		
Cyprinidae					X	
Inland silverside	X	X	X	X	X	X
Killifish	X	X		X	X	
Mosquito fish	X		X		X	X
Threadfin shad	X		X	X	X	X
Brown bullhead					X	
Prickly sculpin	X			X		

*Potential for Exposure of Special Status and
Other Fish to Two-Year Komeen Trials*

The potential exists for impacts to occur to native and listed fish species under the Two-Year Komeen Trials, since these fish do occur in the general project area, whether or not they occur in *Egeria* beds specifically. This section briefly discusses the potential for exposure of special status and other fish to Komeen trial applications.

The DBW proposes to conduct Komeen Research Trials between March and November. Thus, treatments would occur during the critical spawning and rearing period for many fish species, approximately December through June. Larval fish, which are present in the Delta during these months, tend to be much more sensitive to toxins and water quality conditions than are juvenile and adult fish. Not only are larval fish physiologically more sensitive, but they also do not have the same capacity to escape from disturbances as do juvenile and adult fish. **Table 4-4**, on the following page, identifies when various fish, including special status species, spawn in the Delta.

Table 4-4

Spawning Periods for Various Fish in the Delta

Fish Species	Spawning in Delta	Reference
Delta smelt	December-July	Wetland Goals 1997
Splittail	January-July	Wetland Goals 1997
Longfin smelt	December-June	Wang 1986
Striped bass	Peak: May-June	Wetland Goals 1997
Prickly sculpin	January-May	Wang 1986

The Two-Year Komeen Trials treatment period also coincides temporarily with the migration and emigration of certain runs of chinook salmon through the Delta. **Table 4-5** below lists the timing of salmon migration and emigration through the Delta.

Table 4-5

Timing of Adult Migration and Juvenile Emigration of Chinook Salmon Through the Delta (Entrix 1996)

Fish Species/Run	Adult Migration	Emigration
Winter-run chinook	December to June	July to October of following year
Spring-run	March to September	October through April
Late fall-run	October to April	November to January
Fall-run	July to December	April to June

Fish could be directly and indirectly impacted by the Two-Year Komeen Research Trials. Direct impacts could occur through Komeen toxicity or bioaccumulation of the herbicide. Indirect affects include impacts to habitat and to the invertebrate prey base. These impacts are discussed below.

4.2.4.1

Direct Impacts to Fish: Toxicity

Komeen application could potentially result in direct adverse impacts to fish exposed to the herbicide or to its residues following treatment. For Komeen Research Trials, Komeen would be applied twice a year (approximately May/June, and August/September) to three 50-acre plots. Komeen would be applied to achieve a target water column concentration of 0.75 ppm copper. At this concentration, Komeen is not expected to be lethal to most fish species. However, it may be lethal to, or result in sublethal effects to certain fish species,

in particular during early life stages. (Table 4-6 presents the response of various fish species to Komeen.) Further, while the chelated ethylenediamine form of copper used in Komeen has relatively low toxicity to fish, under certain environmental conditions this copper may be re-released into the environment in a more toxic form. Issues related to Komeen toxicity to fish are discussed below.

Table 4-6

Response of Various Fish Species to Varying Concentration of Komeen

Species	LC ₅₀ value (ppm)	Water Hardness (mg/l CaCO ₃) ^a	Comments	Reference
Larval delta smelt	24.4	86	96 hour test	Huang and Guy 1998
Larval delta smelt	14.9	66	96 hour test	Huang and Guy 1998
Larval fathead minnow	4.6	110-150	96 hour test	Trumbo 1997
Larval fathead minnow	2.3*	60-80	*This value is an estimate based on data from Trumbo 1997 and water hardness for Delta.	Huang and Guy 1998
Larval fathead minnow	Not applicable	76	60% survival 3 hours post- treatment at 0.8 ppm	Huang and Guy 1998
Larval fathead minnow	Not applicable	80	70% survival 3 hours post-treatment at 0.4 ppm	Huang and Guy 1998
Larval fathead minnow	Not applicable	80	75% survival 9 hours post-treatment at 0.2 ppm	Huang and Guy 1998
Larval fathead minnow	Not applicable	58	75% survival 9 hours post-treatment at <0.05 ppm	Huang and Guy 1998
Rainbow trout	4.0	Not indicated	48 hour test	Meyers and Stoner 1974
Bluegill	480.0	Not indicated	48 hour test	Meyers and Stoner 1974
Golden shiner	630.0	279	96 hour test	Finlayson 1980
Golden shiner	67.0	20	96 hour test	Finlayson 1980
Channel catfish fry	18.1	Not indicated	96 hour test	Nelson and others 1984
Juvenile channel catfish	46.4	Not indicated	96 hour test	Nelson and others 1984

Toxicity of Chelated Copper Compared to Ionic Copper

Komeen is a copper-based herbicide containing 8 percent elemental copper. The chelated ethylenediamine form of copper used in Komeen is significantly less toxic to aquatic life than are non-chelated forms. The toxicity of copper to fish is directly related to the activity of the free copper ion (Cu²⁺) and possibly to some of the associated hydroxyl substances (Eisler 1997). Huang and Guy (1998) concluded that the chelated form of copper in Komeen appears to be at least one order of magnitude less toxic to fathead minnows than is inorganic copper (96-hour LC₅₀ values equal 170 to 260 ppb), for water of similar hardness.

Results of Komeen Toxicity Tests by DFG

The following summarizes methods and findings from field studies conducted by Huang and Guy 1998 to assess Komeen toxicity to fish and invertebrates following application of Komeen at three sites in the Delta (Sandmound Slough, Seven Mile Slough, and White Slough):

- ❑ Komeen was applied to achieve a water column concentration of approximately 750 ppb copper.
- ❑ Water samples were collected prior to treatment, and at 3, 9, and 24-hours post-treatment. Toxicity tests were conducted within three days of sample collection.
- ❑ Tests performed with water samples collected prior to Komeen treatment and at the negative control site produced no significant mortality to fathead minnow larvae.
- ❑ Only two of the eight water samples collected from Komeen treatment plots three hours post-treatment produced significant mortality (60 percent survival at 800 ppb and 70 percent survival at 430 ppb). Likewise, two of the eight water samples collected from Komeen treatment plots 9 hours post-treatment produced mortality (75 percent survival at 170 ppb and <50 ppb).
- ❑ No mortality was seen in the three samples collected 24-hours post-treatment. (Data from the other five 24-hour samples were not available according to Huang and Guy 1998.)

Other Komeen Toxicity Tests

The following summarizes additional findings related to Komeen toxicity to fish:

- ❑ Trumbo (1997) reports that the LC₅₀ value established for larval fathead minnows using Clear Lake water (high water hardness) was 4,668 ppb copper.
- ❑ Huang and Guy (1998) assert that mortality would generally first be observed at about half this concentration (the incipient lethal level or ILL) or about 2,300 ppb copper. Considering the lower water hardness of Delta water (a condition which increases the toxicity of copper-complexes), an ILL of 1,200 ppb copper is possible (Huang and Guy 1998). This is close to the concentration at which Komeen would be applied during field trials. Therefore, the possibility exists that Komeen concentrations could be lethal to some fish species, especially during the first 9 hours following initiation of the field trial.

- ❑ Mortality due to Komeen may be higher in larval or juvenile fish than adults. A study by Nelson and others (1984) indicated that Komeen was significantly more toxic to channel catfish, *Ictalurus punctatus*, fry (96-hour LC₅₀ value = 18,100 ppb) than to the juvenile life stage of the species (96-hour LC₅₀ value = 46,400 ppb).

Results of Toxicity Tests on Delta Smelt

Toxicity tests with delta smelt (*Hypomesus transpacificus*) conducted by Huang and Guy (1998) indicate that little direct mortality is expected to occur to these fish following exposure to Komeen. The following summarizes methods and findings from these tests:

- ❑ Delta smelt larvae (1 to 10 days old) were exposed to Komeen in toxicity tests conducted according to American Society of Testing and Materials (ASTM) Standard Guides E729-88 and E1192-88. The tests were 96-hours in duration and test solutions were renewed daily. Sacramento River water and San Joaquin River water were used as a diluent and control. Four replicates were tested per treatment. Mortality and water quality characteristics were recorded daily during each test.
- ❑ The toxicity tests conducted on Komeen produced a 96-h LC₅₀ of 14,995 ppb copper using water collected from the San Joaquin River (Huang and Guy 1998). Water from the Sacramento River produced a slightly higher 96-h LC₅₀ value of 24,400 ppb copper. The difference in the two LC₅₀ values is probably due to differences in water hardness and pH.
- ❑ These values are two orders of magnitude higher than the mean copper concentrations that were detected in water samples collected 3 hours after the application of Komeen at the Delta test plots.
- ❑ Huang and Guy (1998) assert that use of Komeen is expected to result in little direct mortality to delta smelt (Huang and Guy 1998).

Toxicity of Komeen to Other Sensitive Fish Species

No tests have been conducted assessing the toxicity of Komeen to the other sensitive fish species found in the Delta, such as chinook salmon, steelhead or splittail. However, LC₅₀ data on the toxicity of Komeen to rainbow trout (a salmonid) is available. Meyers and Stoner (1974) found that, for rainbow trout, the LC₅₀ value for Komeen is 4 ppm. This concentration is four times the concentration that will be used in the EDCP field trials. Salmonids tend to be more sensitive to copper than other species (Trumbo, pers. comm. 1999). Thus it is likely that neither the listed salmonids (chinook salmon and steelhead), nor splittail, would be impacted by the concentrations of Komeen

used in the Komeen trials. As part of the research on Komeen, laboratory toxicity tests (LC₅₀ tests) would be conducted to assess the impact of Komeen on chinook salmon.

Factors Affecting Copper Toxicity

The potential exists for Komeen residues to become ionized, transforming into more toxic forms of copper. Ionized copper is significantly more toxic to aquatic life than is the chelated ethylenediamine form of copper used in Komeen. Copper is not biodegradable and remains in the environment indefinitely. Thus, it is critical to determine under what environmental conditions chelated forms of copper might ionize, and how toxic ionized copper is to fish. The following provides an overview of factors affecting ionization, and information on toxicity of ionized copper.

Factors that Influence and Modify Copper Toxicity

- ❑ **Water Hardness** - Water hardness is a measure of the concentration of calcium and magnesium ions in water and is frequently expressed as ppm calcium carbonate (CaCO₃) equivalent (Rand and Pedrocelli 1985). A commonly used classification is: soft water, 0 to 75 ppm expressed as CaCO₃; moderately hard, 75 to 150 ppm; hard, 150 to 300 ppm; and very hard, 300 ppm and above (EPA, 1976). According to data from the study by Huang and Guy (1998), the Delta would be classified as moderately hard.

Copper toxicity shows a consistent relationship with water hardness. Like most heavy metals, copper becomes less toxic in harder water (Sprague 1985). Predictable relationships have been shown to exist between water hardness and lethal and sublethal concentrations of copper to fish (Sprague 1985). The mitigating function of increased water hardness is generally considered to be a physiological phenomenon within the fish. Sprague (1985) explains that “higher levels of calcium in the fish tissues make the cell membranes in the gills less permeable, so that less metal enters the fish”. The 48-hour median lethal concentration has been shown to range from 0.05 ppm copper at a hardness of approximately 20 mg/l CaCO₃ to 0.3 ppm copper at 200 ppm CaCO₃ (Sprague 1985). These figures indicate that copper toxicity decreases as water hardness increases.

- ❑ **Hydrogen Ion Concentration (pH)** - Since copper can ionize under the influence of pH (the hydrogen ion concentration), this abiotic variable can influence copper toxicity (Sprague, 1985). Indeed, the interacting factors of pH and alkalinity (carbonate-bicarbonate buffering system of the water) can govern the forms of copper present in the water (Spear and Pierce, 1979, quoted in

Sprague, 1985). For example, at pH 5, a large proportion of the copper is present as Cu^{2+} , the cupric ion. However, this concentration drops off precipitously at and above neutral pH. At higher pH, copper carbonates and unionized hydroxides, which are not thought to be toxic, predominate (Sprague, 1985).

From 1970 through 1993, average annual pH in the Delta was 7.7, with a range of 6 to 8 among regions (DWR, 1996). Thus, it is unlikely that ionization of chelated copper would occur in these waters. It has been asserted that the chelated copper use in Komeen would only become ionized if a catastrophic spill of acid were to occur in the trial site (Lars Anderson pers. comm., 1999).

- ❑ **Suspended and Dissolved Organic Matter -** Copper toxicity is also decreased by suspended and dissolved materials in surface waters through binding or sorption by these materials (Sprague 1985). Eisler (1997) asserts that “in hard, moderately polluted waters, 43 to 88 percent of the copper is associated with suspended solids and not available to biota.” With regard to the mitigating impact that organic compounds have on copper toxicity, Eisler makes the following points:

“Sequestering agents, increasing salinity, sediments, and other variables all reduce toxicity and accumulation of copper in tested species of aquatic plants and invertebrates. Chelating agents, such as nitrilotriacetic acid, reduce the toxicity of ionic copper to six species of estuarine phytoplankton. Sensitivity of freshwater zooplankton communities varies seasonally. Communities are most sensitive to copper stress (20 or 40 $\mu\text{g Cu/L}$) during exposure for 5 weeks in spring rather than in summer or autumn, because, in part, of reduced dissolved organic carbon concentration in the spring (Winner et al., 1990). Further, Daly et al. (1990) studied the influence of dissolved organic matter on the toxicity of copper to an Australian freshwater shrimp in laboratory studies. They found the presence of dissolved organic material dramatically reduced the toxicity of copper, presumably through the formation of nontoxic copper organic complexes.

“Due to the high concentration of minerals and organic compounds in Delta waters, the chelated form of copper used in Komeen would be less biologically available than it would be in oligotrophic (i.e. nutrient poor) waters. This would further reduce the effective toxicity of Komeen.

“Biological Variables - Copper toxicity is modified in part by biological variables. Eisler (1997) asserts that “biological variables affecting copper accumulations in marine organisms include the organisms' age, size, and developmental stage; physiological or genetic adaptation to high copper substrates; inherent species differences; and tissue specificity, such as the thorax of barnacles, gill and osphradium of gastropods, and livers of teleosts.”

Toxicity of Ionic Copper to Fish

Despite these abiotic and biotic factors that modify copper toxicity, it must be acknowledged that copper is not biodegradable and remains in the environment indefinitely (Nelson 1984). As indicated above, copper in its free or ionic form is much more toxic to aquatic organisms than is chelated copper. Regarding impacts to fish, Eisler (1997) asserts the following:

“Copper exerts a wide range of physiological effects in fishes....At environmentally realistic concentrations, free copper [the dissolved cupric ion, Cu^{2+}] adversely affects resistance of fishes to bacterial diseases; disrupts migration (that is, fishes avoid copper contaminated spawning grounds); alters locomotion through hyperactivity; impairs respiration; disrupts osmoregulation through inhibition of gill $\text{Na}^+ - \text{K}^+$ activated ATPase; is associated with tissue structure and pathology of kidneys, liver, gills and other hematopoietic tissue; impacts mechanoreceptors of lateral line canals; impairs functions of olfactory organs and brain; and is associated with changes in blood chemistry, enzyme activities, and corticosteroid metabolism (Hodson et al. 1979).”

The report states that the rate and extent of copper accumulations in fish tissues are extremely variable between species and are further modified by the biologic and abiotic variables cited above. In general, mortality of tested aquatic species is greatest under conditions of low water hardness (as measured by CaCO_3), starvation, elevated water temperature, and among early developmental stages (Hodson et al. 1979).

Eisler (1997) asserts that adverse sublethal effects of copper on behavior, growth, migration, and metabolism occur in representative species of fishes at nominal water concentrations between 4 and 10 ppb.

Copper toxicity tests conducted on salmonids indicate that these fish are among the most sensitive to ionic forms of copper. Chinook salmon are among the aquatic organisms most sensitive to copper. LC_{50} values range from approximately 13 ppb in rainbow trout fry, to approximately 32 ppb in juvenile chinook salmon. **Table 4-7**, on the following page, presents the response of various fish to ionized copper. Concentrations are shown in parts per billion (ppb), as opposed to parts per million (ppm), as in the previous toxicity tables. Note that a lethal effect is achieved at a much lower concentration of ionized copper than with a chelated form.

Table 4-7

**Response of Various Salmonids to
Varying Concentrations of Copper¹**

Species	LC50 value (ppb)	LC10 value (ppb)	Water Hardness (mg/l CaCO ₃)	Comments	Reference
Chinook salmon fry	17-49	14-32	21-27	96 hour test	Finlayson and Verrue 1982
Chinook salmon juveniles	32 +/- 4	19 +/- 3	20-22	96 hour test	Finlayson and Verrue 1982
Rainbow trout smolts	Not indicated	7	Not indicated	200 hour test	USEPA 1980
Rainbow trout juveniles	13.8	Not indicated	Not indicated	96 hour test	Buhl and Hamilton 1990
Rainbow and steelhead trout	20, 22, 33	Not indicated	10-50	96 hour tests	Chapman 1973; Colorado Game, Fish and Parks 1971; McKim & Benoit 1971
Striped bass larvae	50-100	Not indicated	68	96 hour test	USEPA 1980
Channel catfish fingerlings	54-55	Not indicated	16	96 hour test	Straus and Tucker 1993

¹ Please note that the concentrations shown here are reported in parts per billion (ppb) rather than parts per million (ppm) as in the previous toxicity data tables.

Clearly, ionized copper in the water column can result in lethal and sublethal effects to fish (Finlayson and Verrue 1982, Eisler 1997). However, it is not clear under what environmental conditions the chelated compound used in Komeen would ionize to a more toxic form. This issue would be a primary focus of Two-Year Komeen Research Trials. Results from these trials would help determine the significance of the potential impacts from Komeen application.

*Overall Assessment of Potential Impacts to Fish
due to Komeen and Copper Residues*

In conclusion, research indicates that the Komeen can be lethal to some fish species (e.g. fathead minnow larvae), although it is not expected to be lethal to most fish species including delta smelt, splittail chinook salmon or steelhead at the concentrations used during Research Trials. Under certain conditions, chelated copper may become ionized, forming a more toxic copper substance. Significant impacts to fish could occur if the chelated copper compound in Komeen were to become ionized following application. The potential for ionization to occur is not clear. A conservative evaluation must conclude that the potential exists for use of Komeen to result in sublethal or lethal effects to fish, possibly including special status fish species.

In conclusion, Komeen application could result in unavoidable potentially significant impacts to fish, including special status species.

4.2.4.2

Direct Impact to Fish: Bioaccumulation

Herbicide use under the Two-Year Komeen Trials could potentially result in bioaccumulation of toxic substances in the food chain. This could impact fish as well as wildlife species that prey upon those fish. Further, as discussed in Section 4.5.2.1.3 (Hazards), if Komeen bioaccumulates in tissues of fish or invertebrates commonly consumed by human beings, adverse impacts to human health could result.

Bioaccumulation Defined

Bioaccumulation is an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. Compounds accumulate in organisms whenever they are taken up and stored faster than they are broken down (metabolized) or excreted (EXTOXNET 1993).

A number of terms are used in conjunction with bioaccumulation. Bioconcentration is the specific bioaccumulation process by which the concentration of a chemical in an organism becomes higher than its concentration in the air or water around the organism. Although the process is the same for both natural and man-made chemicals, the term bioconcentration usually refers to chemicals foreign to the organism. For fish and other aquatic animals, bioconcentration after uptake through the gills (or sometimes the skin) is usually the most important bioaccumulation process. Biomagnification describes a process that results in the accumulation of a chemical in an organism at higher levels than are found in its food. It occurs when a chemical becomes increasingly concentrated as it moves through a food chain (EXTOXNET 1993).

Bioaccumulation Pathways

Bioaccumulation of chemicals in herbicides can occur in fish tissues due to direct uptake through the gills or skin (EXTOXNET 1993) or by consumption and ingestion of invertebrates or other fish that have bioaccumulated these chemicals. Wildlife can potentially bioaccumulate herbicides either by direct uptake through the skin (in the case of frogs and aquatic snakes), drinking of water treated by an herbicide, or consumption of fish and other organisms that had bioaccumulated the herbicide. The potential for bioaccumulation to occur, as well as the potential impacts due to bioaccumulation, depend on the ingredients of the herbicide, environmental conditions, and the physiology of the organism exposed to the herbicide.

Komeen Application

The potential exists for bioaccumulation of copper to occur in aquatic organisms due to the application of Komeen, during the Komeen Research Trials. The following summarizes research finding on bioaccumulation of Komeen:

- ❑ Trumbo (1998) analyzed copper accumulation in crayfish (*Pacifastacus leniusculus*) and the aquatic snail (*Physa sp.*) prior to and following Komeen applications at Clear Lake. Trumbo asserts that the small sample size made it difficult to draw any firm conclusions regarding the potential for bioaccumulation. However, copper concentrations in crayfish tissues collected at Komeen treated sites were higher than those from control sites (42.1 and 28.2 ppb, compared to 9.4 ppb at the control). These values are similar to those found during the 1996 monitoring program (Trumbo 1997) (44.1 ppb at treatment site; 14.5 ppb at the control).
- ❑ Trumbo (1998) found that copper concentration in snails collected at Komeen treated sites were higher than those from control sites (103.8 ppb compared to 46.1 ppb at the control site).
- ❑ Rodgers and others (1990) conducted a field study in which Komeen was applied to a reservoir in North Alabama. Following treatment, copper concentrations were determined in caged fish (bluegill sunfish, *Lepomis sp.*) and Asiatic clams (*Corbicula fluminea*). Copper concentrations in the water column were elevated to 166 ppb by six hours following treatment. (Background level was 5.35 ppb.) Copper concentrations in fish tissue increased from background (26.1 ppm) to 50.0 ppm at 48 hours. Mollusk copper levels increased from background (37.9 ppm) to 81.2 ppm at six hours and slowly decreased to 46.8 ppm at day 29.
- ❑ Rodgers and others (1992) assert that bioconcentration and bioaccumulation of copper in biota cannot currently be interpreted and that the response could differ based on the route of exposure and the ability of the organism in question to “neutralize” copper in internal and external tissues.

These findings suggest that copper from Komeen can accumulate in the tissues of some aquatic organisms. Of course, bioaccumulation of copper would be less likely to occur in a lotic (flowing water) environment, such as the Delta, than in a lentic (standing water) environment, such as a lake. These studies did not assess the impact of bioaccumulation of Komeen or copper on the organisms being studied. A primary aim of the Komeen Research Trials is to ascertain whether bioaccumulation of Komeen results in adverse/sub-lethal to aquatic organisms. However, considering the potential for adverse sub-

lethal effects due to exposure copper, a conservative assessment must conclude that bioaccumulation of Komeen has the potential to result in adverse impacts to aquatic organisms, including special status fish species.

In conclusion, bioaccumulation of Komeen would be an unavoidable significant impact to fish, potentially including special status species.

4.2.4.3

Indirect Impacts to Fish Habitat: Impacts to Habitat

Loss of Acreage of Egeria in Shallow Water Habitat

An indirect impact to fish, including special status species, could occur through alteration of spawning, rearing, and foraging habitat. The definition of harm under the Endangered Species Act (ESA) prevents major acts of habitat destruction and degradation that prevent a species from breeding, feeding, and sheltering (Mueller 1994). Special status fish species could be impacted by removal of large beds of aquatic plants that they use as habitat. As explained, available data does not indicate that any threatened, endangered, or special status fish species use *Egeria* beds for spawning, rearing, or forage. Nor have any migratory fish, such as steelhead or chinook salmon, been observed in *Egeria* beds. However, while there is not evidence that *Egeria* beds function as habitat for these fish, it is possible that in some instances they do serve habitat functions. Thus, their removal could negatively impact sensitive fish species to some extent due to loss of cover, rearing, and forage areas.

However, this potentially adverse impact would likely be more than offset by the benefits derived from opening up substrate for native aquatic plants. Removal of *Egeria* would likely result in improvements to fish habitat, if by enabling native aquatic vegetation to colonize areas previously dominated by *Egeria*. While *Egeria* is generally too dense for spawning, rearing, and foraging by native fish, native aquatic vegetation, which is generally less dense, is ideal for these functions.

Loss of Native Aquatic Plants

Treatment of *Egeria* is likely to remove native aquatic plants growing near treatment sites. Native plants may be utilized frequently by special status fish for rearing, cover and forage. In particular, shallow vegetated habitat is believed to be important to the spawning success of splittail and delta smelt. Loss of cover, rearing, and forage area to special status species could constitute a significant impact if large enough areas of native plants are removed.

While loss of habitat is an important impact to consider, it is unlikely that the Two-Year Komeen Trials would result in significant loss of native aquatic vegetation. As discussed in Section 4.2.2.1, only sites that exhibit a high percentage of *Egeria* (approximately 85 percent relative abundance) were chosen for the treatment. Further, the Two-Year Komeen Trials would treat approximately 150 acres of *Egeria* each year. This is a small percentage of the total amount of the shallow water habitat present in the Delta. The area of lost vegetated habitat would be small relative to the area of similar habitat available in the area, thus such habitat loss should have minimal effects on fish populations.

Impacts to Habitat due to Decreases in Dissolved Oxygen

Another potential impact to habitat could occur due to the rapid decay of *Egeria*, other aquatic macrophytes, and algae, following application of certain herbicides. Decomposition of this vegetative material may create an organic carbon slug, which could in turn reduce dissolved oxygen concentrations. Low dissolved oxygen can result in fish kills and impede migration of salmonids.

Komeen Application

Aquatic plant removal due to application of Komeen is not likely to significantly impact sensitive fish species due to loss of cover, and spawning, rearing and forage area. Successful applications of Komeen could result in semi-permanent removal of *Egeria* from the treatment site. Since Komeen is a non-selective herbicide, native plants within and adjacent to the treatment areas may also be removed. Further, Komeen is expected to result in approximately 70 percent efficacy over a two-year period. However, a total of 150 acres would be treated with Komeen each year. As indicated before, the area of lost vegetated habitat would be small relative to the area of similar habitat available in the Delta. Thus, such habitat loss would have minimal effects on fish populations. Further, removal of *Egeria* could enable recolonization by native aquatic species, which could be beneficial to fish. In conclusion, impacts to sensitive fish species due to loss of native vegetation and *Egeria* would be a less than significant impact.

Potential for Decreases in Dissolved Oxygen

The effect of Komeen applications on dissolved oxygen concentration is discussed under Section 4.1.1.2.4. In conclusion, Komeen application would result in less than significant impacts to fish habitat, with respect to the herbicide's impact on dissolved oxygen.

4.2.4.4

Indirect Impacts to Fish: Decrease in Abundance of Invertebrate Prey Base

Special status fish species could be impacted indirectly if the EDCP decreased the abundance of invertebrates upon which these fish feed. If application of Komeen resulted in a high mortality to certain invertebrates, fish that feed on those invertebrates could be adversely affected.

Prey Base of Special Status Fish Species

Juvenile chinook salmon feed on various aquatic and terrestrial insects, crustaceans, chironomid larvae and pupae, caddisflies (in fresh water), and *Neomysis* spp., *Gammarus* spp. and *Crangon* spp. in more saline water (Wang 1986). Juvenile delta smelt primarily eat planktonic crustaceans, small insect larvae, and mysid shrimp, while older fish feed almost exclusively on copepods (Moyle 1976). Splittail are opportunistic benthic foragers that consume copepods, dipterans, detritus, algae, clams, and amphipods. Herbold (1987) found that splittail select *Neomysis* as their main prey item in the estuary.

Aquatic Invertebrates That Occur in Stands of Egeria

Exhibit 4-4 in Section 4.2.3.1 identifies aquatic invertebrates found in *Egeria*. Several of these invertebrates, in particular various crustaceans including copepods and dipterans, are consumed by special status species such as splittail, juvenile chinook salmon, and delta smelt (Moyle 1976, Wang 1986, and Herbold 1987).

Loss of certain aquatic invertebrates, such as copepods and dipterans, could be potentially significant to delta smelt, given that delta smelt abundance is believed correlated with invertebrate abundance. However, this impact would likely be temporary, since planktonic (floating) invertebrates, such as zooplankton and shrimp, would be reintroduced to treatment areas inadvertently through water flow. Further, benthic (bottom dwelling) organisms and plant-dwelling organisms likely would recolonize a treatment area relatively rapidly once regrowth of plant material began.

Komeen Application

The affect of Komeen on aquatic invertebrate abundance is discussed above under 4.2.3.1. In conclusion, Komeen application could result in an unavoidable significant impact to fish, including special status species, due to the effect of the herbicide on invertebrate abundance.

4.2.5 Wildlife

4.2.5.1 Reptiles and Amphibians

Reptiles and amphibians could be adversely affected by exposure to herbicide-treated water, or by impacts to channel bank habitat. Impacts to channel bank habitat include loss of intertidal wetland vegetation due to herbicide use.

The following special status reptiles and amphibians utilize the sloughs, channels and channel banks in the Delta and could be impacted by Trial activities: giant garter snake, Northwestern and Southwestern pond turtles, and the California red-legged frog.

Komeen Application

No information is available on the toxicity of Komeen or its active ingredient, copper, to reptiles and amphibians. Absent this information, it must be assumed, since Komeen is a toxic substance, that exposure of reptiles and amphibians to this herbicide could result in loss or sublethal effects to individual animals. Further, as discussed in Section 4.2.2.2, Komeen could result in loss of wetland intertidal vegetation, which may serve as habitat for certain reptiles and amphibians.

In conclusion, Komeen use could result in unavoidable significant impacts to reptiles and amphibians, including the special status species mentioned above, due to its toxicity and effect on channel bank habitat. This would be a less than significant impact.

4.2.5.2 Birds

Birds could be adversely affected by exposure to herbicide-treated water or by impacts to channel bank habitat where nesting may occur. Impacts to habitat include loss of intertidal wetland vegetation due to herbicide use.

Waterfowl could be inadvertently impacted if “managed wetlands” (i.e., flooded agricultural fields) in the Delta were inadvertently flooded with herbicide-treated water. Many agricultural fields are flooded in the winter to provide foraging and roosting sites for migratory waterfowl. However, since no Trials would occur during winter flood-up, no impacts of this type would occur.

In the recent past, much concern has been directed toward the impact of channel and channel bank activities on Swainson's hawks (State listed threatened), which occasionally nest in trees along channel banks in the Delta.

The Swainson's hawk nesting season is March 15 through September 1, which coincides with Two-Year Komeen Trials activities. However, no adverse impacts are expected to occur to this species for two reasons. First, treatment in any given area would be temporary (1-2 days), thus any disturbance would be short-lived. Second, Swainson's hawks can tolerate a relatively high degree of human activity adjacent to their nests (Bradbury, pers. comm.). Thus, nesting birds are unlikely to be disturbed by project-related activities.

The following special status bird species utilize the sloughs, channels and channel banks in the Delta and could be impacted by Trial activities: California black rail, greater sandhill crane, short-eared owl, tricolored blackbird and white-faced ibis.

Komeen Application

No information is available on the toxicity of Komeen or its active ingredient, copper, to birds. Absent this information, it must be assumed, since Komeen is a toxic substance, that exposure of birds to this herbicide (through ingestion of water or external contact) could result in loss or sublethal effects to individual birds.

Additionally, as discussed under 4.2.4.1.2, the potential exists for bioaccumulation to occur to various fish species and aquatic organisms following exposure to the herbicide. Thus, piscivorous birds could be impacted by consuming fish or other aquatic organisms containing herbicide residues.

Further, as discussed in Section 4.2.2.2, Komeen could result in loss of intertidal wetland vegetation, which may serve as habitat for certain birds, including special status species such as California black rail, and tricolored blackbird.

In conclusion, Komeen application could result in unavoidable significant impacts to birds, including special status species, due to its toxicity, potential for bioaccumulation, and effect on channel bank habitat.

4.2.5.3

Mammals

Exposure of mammals to Two-Year Komeen Trial activities is expected to be minimal. Mammals could be affected by changes in channel bank habitat following herbicide treatments, or due to staging or maneuvering of mechanical harvesting equipment. However, no special status mammals live along Delta channel banks, thus this impact would be less than significant.

The following special status species utilize the sloughs, channels and channel banks in the Delta: Small-footed myotis bat and Yuma myotis bat. Since these bats forage for insects over water, they could potentially be impacted

indirectly if herbicide treatments reduced insect abundance. However, as discussed in Section 4.2.3.2, the Two-Year Komeen Trials would not significantly reduce insect abundance in the Delta. Impacts to these special status species would be less than significant.

Komeen Application

As explained above, the Two-Year Komeen Research Trials would result in less than significant impacts to mammals.

4.2.6 Significance Determination for Biological Resources

Komeen application would result in the following unavoidable, avoidable, and less than significant impacts to biological resources. Affected acreage would be 150 acres for the two year trial period.

4.2.6.1 Plants

Unavoidable Significant Impacts

- ☐ Unavoidable significant impact to intertidal wetland plant species, including special status species, due to Komeen application. Mitigation measures are proposed to minimize this impact to the extent possible.

Avoidable Significant Impacts

- ☐ None.

Less Than Significant Impacts

- ☐ Less than significant impact to native aquatic plants and algae due to Komeen application.
- ☐ Less than significant impact to terrestrial plants due to Komeen application.

4.2.6.2 Invertebrates

Unavoidable Significant Impacts

- ❑ Unavoidable significant impact to aquatic invertebrate abundance due to toxicity of Komeen. Mitigation is proposed to decrease impact significance to the extent possible.

Avoidable Significant Impacts

- ❑ Avoidable significant impact to Valley elderberry longhorn beetle, due to inundation of elderberry with Komeen-treated water. Mitigation is proposed to reduce this impact to a less than significant level.

Less Than Significant Impacts

- ❑ None.

4.2.6.3 Fish

Unavoidable Significant Impacts

- ❑ Unavoidable potentially significant impact to fish, including special status fish, due to toxicity of Komeen and copper residues. Mitigation is proposed to decrease impact significance to the extent possible.
- ❑ Unavoidable significant impact to fish, including special status fish, due to bioaccumulation of Komeen. Mitigation is proposed to decrease impact significance to the extent possible.
- ❑ Unavoidable significant impact to fish, including special status fish, due to decrease in invertebrate prey base, resulting from Komeen applications. Mitigation is proposed to decrease impact significance to the extent possible.

Avoidable Significant Impacts

- ❑ None.

Less Than Significant Impacts

- ❑ Less than significant impact to habitat, with respect to the affect of Komeen on dissolved oxygen concentration and loss of native vegetation.

4.2.6.4 Wildlife

Unavoidable Significant Impacts

- ❑ Unavoidable significant impact to reptiles and amphibians due to Komeen toxicity and effect on habitat. Mitigation is proposed to decrease impact significance to the extent possible.
- ❑ Unavoidable significant impact to avian species due to Komeen accumulation in food chain and effect on habitat. Mitigation is proposed to decrease impact significance to the extent possible.

Avoidable Significant Impacts

- ❑ None.

Less Than Significant Impacts

- ❑ Less than significant impact to mammals due to Komeen application.

4.2.7 Mitigation Measures for Impacts to Biological Resources

In addition to all mitigation measures described below, all field personnel would be trained in sensitive species awareness and impact avoidance prior to beginning field work.

4.2.7.1 Plants

Mitigation Measures for Impacts to Intertidal Wetland Plants

- ❑ Prior to Komeen application, channel banks would be surveyed by a qualified biologist to determine whether sensitive plant species are present. If the site exhibits a high percentage of sensitive plants, the site may not be treated. To the degree possible, herbicide application would occur during low tide to decrease the likelihood that sensitive plants would be inundated by herbicide-treated water. Herbicide application would be focused in the mid-channel region to decrease the possibility that concentrated herbicides would come in contact with sensitive plants growing along channel banks. Following herbicide treatment, channel banks would be surveyed to determine whether loss of sensitive plants has occurred. If substantial loss is evident, changes may be made to the treatment protocol.

4.2.7.2 Invertebrates

Mitigation Measures for Impacts to Invertebrates

- ❑ No more than 20 acres would be treated with Komeen at any given site on a given day. Upstream portions would be treated first, and downstream portions would be treated 14 days later. This period of time would likely be sufficient to allow for recolonization of invertebrates.

Mitigation Measures for Impacts to Valley Elderberry Longhorn Beetle

- ❑ Prior to treatment, surveys would be conducted to determine whether sensitive species are present. Herbicide treatments would not occur along channels where elderberry shrubs could be adversely impacted.

4.2.7.3 Fish

Mitigation Measures for Impacts to Fish

- ❑ In order to avoid impacts to sensitive fish species due to the Komeen field trials, the following avoidance measures would be used. First, treatment and trials would adhere to all regulatory requirements identified by the regulatory agencies, such as USFWS, NMFS and CDFG. These could involve, for example, suspending herbicide treatment for specific periods of time to avoid disrupting fish migration or spawning, or avoiding certain habitat conditions. Prior to treatment, Interagency Ecological Program (IEP) Real Time Monitoring data would be obtained and evaluated (if available and relevant to the treatment site) to determine whether any sensitive fish species had been identified in the treatment area. Further, pre-treatment monitoring would be conducted by a qualified biologist following the sampling protocol for pop-net surveys established by McGowan 1998 to further assess the presence of threatened, endangered or sensitive fish species in the vicinity of the project site. This monitoring would be conducted 1 to 2 days prior to the commencement of treatment. If the number of sensitive fish identified through the IEP data or the pop-net surveys were above a certain threshold level, treatment would be postponed until additional surveys indicated that fewer sensitive fish were present in the area. The threshold number would be determined through consultation with the USFWS and the CDFG.

- ❑ Dissolved oxygen would be measured throughout the water column. If dissolved oxygen were below 5 ppm in the hypolimnion, treatment would be delayed until dissolved oxygen levels increase.
- ❑ The proposed pre-treatment avoidance and minimization measures would decrease the possibility of bioaccumulation occurring, by decreasing the possibility that sensitive fish species would be exposed to Komeen. No other mitigation is available to reduce this impact to a less than significant level.

These minimization and avoidance measures would minimize the possibility that direct adverse impacts would occur to fish due to use of Komeen. However, the measure would not necessarily reduce the impact to a less than significant level.

Additionally, it should be noted that the Komeen field trials would include substantial monitoring of water column conditions. As part of the Komeen field trials, dissolved oxygen, pH and total and dissolved copper concentrations will be measured at discrete intervals throughout the water column at 0, 3, 6, 12, 24, 48 hours and, in the case of dissolved oxygen, daily for eight days following treatment. Additionally, six sediment monitoring stations will be established (three in high flow locations and three in low flow locations) within the three treatment sites. At each site, the following will be monitored prior to and following the two herbicide applications: (1) total copper in upper 5 cm of sediment; (2) dissolved and ionic copper in sediment pore-water; (3) sedimentation rate; (4) water and sediment pH and redox; (5) percent organic matter; (6) bottom (sediment surface) water temperature; and (7) mid-depth water samples for copper analysis (total dissolved, ionic). Additionally, laboratory tests will be conducted to determine the toxicity of Komeen to chinook salmon.

While this monitoring cannot be considered mitigation for potential impacts, these data would be used to assess potential impacts of the treatments and make adjustments to any future treatment plans.

4.2.7.4

Wildlife

Mitigation Measures for Impacts to Reptiles and Amphibians

- ❑ Prior to treatment, channel banks and uplands adjacent to treatment sites would be surveyed by a qualified biologist to assess whether sensitive species are present. If evidence suggests that a relatively large number of sensitive species are present along channel banks, a new location for the Komeen trials would be selected. There is no mitigation for in-channel impacts to reptiles and amphibians.

Mitigation Measures for Impacts to Birds

- ❑ Prior to treatment, channel banks and uplands adjacent to treatment sites would be surveyed by a qualified biologist to assess whether sensitive species are present. If evidence suggests that a relatively large number of sensitive species are present along channel banks, a new location for the Komeen trials would be selected. There is no mitigation for in-channel impacts to reptiles and amphibians. Mitigation measures for fish above would minimize the possibility that special status bird species would be exposed to Komeen. There is no mitigation to avoid bioaccumulation of Komeen in non-special status bird species.

4.3 Agricultural Resources

This section assesses impacts of the Two-Year Komeen Trials to agricultural resources in the Delta. Baseline information on Agricultural Resources is contained in Section 2.3 of Chapter 2. Exhibit 4-2 describes impacts to agricultural resources and proposed mitigation measures, and indicates impact significance both pre- and post-mitigation.

CEQA Guidelines (Appendix I, Appendix G) indicate that a project may significantly impact agricultural resources if it:

- ☐ Is incompatible with existing land use in the vicinity;
- ☐ Affects agricultural resources or operations; or
- ☐ Impairs the agricultural productivity of prime agricultural land.

Under the Two-Year Komeen Trials, agricultural operations may be impacted. This could potentially impair agricultural productivity of the Delta.

4.3.1 Agricultural Resources Significance Threshold

A significant agricultural impact occurs when a project substantially and adversely limits the ability to use affected property in accordance with existing or designated land uses. In accordance with CEQA, and for the purposes of this EIR, agricultural impacts are considered significant if implementation of a proposed action would directly or indirectly convert prime agricultural land to nonagricultural use, or impair the agricultural productivity of prime agricultural land.

4.3.2 Environmental Impacts/Consequences to Agriculture

If research plots are adjacent to agricultural intakes, adverse impacts could occur to nearby agricultural crops, since irrigation with herbicide-treated water may result in injury to irrigated vegetation. Komeen has the potential to reduce growth or possibly kill crops. Thus, under the proposed trials, the potential exists to impair the agricultural productivity of prime agricultural land.

Undiluted Komeen or concentrations above 1.0 ppm may be injurious to crops, grass and ornamentals. The Komeen label does not specify a particular period of time that must elapse prior to commencement of irrigation. However, studies assessing the persistence of Komeen in the water column have indicated that copper concentrations at Komeen-treated sites generally

decrease to background levels within 24 hours of treatment (Anderson 1998). In conclusion, impacts to agricultural resources due to the use of Komeen would be a significant avoidable impact.

4.3.3 Significance Determination for Agricultural Resources

Unavoidable Significant Impacts

- ☐ None.

Avoidable Significant Impacts

- ☐ Avoidable significant impact to agricultural resources, due to Komeen use. Approximately 150 acres would be directly affected each year by this impact, unless mitigation measures were incorporated.

Less Than Significant Impacts

- ☐ None.

4.3.4 Mitigation Measures for Agricultural Resources

Measures to Avoid and Minimize Impact to Agricultural Crops and Agricultural Operations

Prior to beginning field trials that are to occur near agricultural diversions, the appropriate County Agricultural Commissioner's Office would be contacted. The DBW and the Commissioner's Office could negotiate ideal times for treatments. Local landowners could then be informed of the particular periods of time during which irrigation should not occur.

As a further precaution against impacts to irrigated crops, post-treatment monitoring would include sampling for water quality parameters, including measuring of herbicide concentrations in the water column at regular intervals following treatment. Following treatment, concentrations of Komeen would be monitored in the water 48 and 96 hours following treatment. Samples would be processed by a qualified analytical laboratory. Once herbicide levels have decreased to less than harmful concentrations, the DBW would contact the appropriate County Agricultural Commissioner's Office, who could in turn contact nearby landowners.

4.4 Utilities and Service Systems

This section assesses impacts of the Two-Year Komeen Trials to utilities and service systems in the Delta. Baseline information on the utilities and service systems of the Delta is presented in Section 2.4 of Chapter 2. Exhibit 4-2 describes impacts to utilities and service systems and proposed mitigation measures, and indicates impact significance pre- and post- mitigation.

CEQA Guidelines (Appendix I, Appendix G) indicate that a project may significantly impact utilities and service system if it would require substantial alterations to the following utilities:

- ☐ Power or natural gas
- ☐ Communication systems
- ☐ Local or regional water treatment or distribution facilities
- ☐ Sewer or septic tanks
- ☐ Storm water drainage
- ☐ Solid waste disposal
- ☐ Local or regional water supplies.

The only utility or service systems that could potentially be impacted by the proposed Two-Year Komeen Trials are local or regional water treatment or distribution facilities. While Section 4.1 discussed contamination of drinking water supplies, this section focuses on the potential impacts to water supply operations.

4.4.1 Utilities and Service Systems Significance Threshold

For the purposes of this analysis, utilities and service system impacts are considered significant if implementation of a proposed action would directly or indirectly result in a need for new systems or supplies, or substantial alteration to the following utilities: power or natural gas; communications systems; local or regional water treatment or distribution facilities; sewer or septic tanks; storm water drainage; solid waste disposal; or local or regional water supplies.

4.4.2 Environmental Impacts/Consequences to Utilities and Service Systems

The primary utility diverting water for drinking supplies is the Contra Costa Water District (CCWD). CCWD has intake facilities at three locations in the Delta:

- ☐ Rock Slough
- ☐ Mallard Slough
- ☐ Old River south of Highway 4 Crossing.

Komeen Application

Municipal water utilities, such as the CCWD, could be adversely affected due to increased debris load at intake facilities, if Komeen Research Trials were occurring nearby. Debris load could be increased if dead plant material became dislodged following herbicide treatments and clogged intake screens and/or pumps. However, Komeen application is unlikely to result in such an impact, since trial sites are not in close proximity to any intakes. In conclusion, Komeen application could result in avoidable significant impact to municipal water operations, if trial sites were in the vicinity of intake facilities.

4.4.3 Significance Determination for Utilities and Service Systems

Unavoidable Significant Impacts

- ☐ None.

Avoidable Significant Impacts

- ☐ Avoidable significant impact to municipal water operations if Research Trials occurred in the vicinity of intake facilities. Mitigation is proposed to reduce this to a less than significant level.

Less Than Significant Impacts

- ☐ None.

4.4.4 Mitigation for Utilities and Service Systems

The DBW would consult with the appropriate drinking water utilities to determine when treatments would occur. Consultation would occur at least two weeks prior to commencement of treatment. Further, a one-mile buffer zone would be established around water treatment plant intakes. No herbicide or mechanical harvesting treatments would occur within this buffer zone while utilities are drawing water. Treatments within buffer zones would be coordinated with utilities. The DBW would coordinate with the appropriate public water agencies to establish these buffer zones.

4.5 Hazards and Hazardous Materials

This section focuses on hazards that could potentially occur due to the Two-Year Komeen Trials. Baseline information on potential hazards in the Delta is presented in Section 2.5 of Chapter 2. Exhibit 4-2 describes impacts and proposed mitigation measures from hazards, and indicates impact significance pre- and post-mitigation.

CEQA Guidelines (Appendix I, Appendix G) indicates that a project may pose a significant hazard if it involved:

- ☐ A risk of accidental explosion or release of hazardous substances (including, but not limited to: oil, pesticides, chemicals, or radiation);
- ☐ Possible interference with an emergency response plan or emergency evacuation plan;
- ☐ The creation of any health hazard or potential health hazard;
- ☐ Exposure of people to existing sources of potential health hazards; or
- ☐ Increased fire hazard in areas with flammable brush, grass, or trees.

The Two-Year Komeen Research Trials could potentially expose people and the environment to hazardous substances.

4.5.1 Significance Criteria for Hazards and Hazardous Materials

The criteria used to determine whether identified impacts are significant and adverse were developed using of the CEQA Guidelines. For the purposes of this analysis, an action would have a significant effect if it would create a potential public health hazard or involve the use, production, or disposal of material, which pose a hazard to people in the area affected, or interfere with emergency response plans or emergency evacuation plans.

4.5.2 Environmental Impacts/Consequences

4.5.2.1 Impacts to Human Health

People may be exposed to Komeen in the following ways: (1) consumption of drinking water contaminated with Komeen; (2) consumption of fish or other aquatic organisms that have bioaccumulated herbicide residues; (3) swimming or water skiing in areas recently treated with Komeen; (4) handling of concentrated formulations of Komeen during the application process. The

discussion below first presents background information on Komeen toxicity, then assesses the probability that humans would be adversely impacted by exposure to the herbicide in any of the ways mentioned above. Finally, mitigation measures are proposed to minimize the possibility that exposure would occur. Finally, mitigation measures are proposed to minimize the possibility that exposure would occur.

4.5.2.1.1 Toxicity

This discussion touches upon the impact of inert ingredients on herbicide toxicity. The following overview is presented to clarify the treatment of inert ingredients during the herbicide registration process.

Herbicide compounds consist of an active ingredient and various inert ingredients, that is, ingredients that do not exhibit herbicidal activity. These substances perform secondary functions, such as aiding the thickening or dispersal of the active ingredient. Typically, information on inert ingredients is classified, and thus not available for publication. In some instances, toxicological effects can result from both the inert and active ingredients.

Federal law requires that aquatic herbicides undergo a thorough evaluation and registration process before they can be shipped or sold in the United States. To obtain registration, manufacturers are required to conduct numerous studies (i.e. over 120 depending upon the intended uses). Further, they must submit a thorough and extensive data set to USEPA to demonstrate that, under its conditions of use, the product would not pose a significant risk to human health and the environment, and that the herbicide is effective against target weeds or plants. Although these documents are classified, they are considered, under CEQA (Pub. Res. Code. Sec. 21080.5) to be the functional equivalent of a full-scale environmental impact report. As such, these documents must include a discussion of environmental impacts, mitigation measure and alternatives.

Komeen has been through this review process. Previous discussions of impacts resulting from Komeen application have covered toxicological effects of the active ingredients, as well as of the entire herbicide formulation. Thus, any impacts due to inert ingredients would have been covered in the discussions of the latter.

Toxicity of Komeen

The following presents information on Komeen obtained from the Material Safety Data Sheet (Griffen 1997). Komeen is:

- ❑ Toxic if inhaled. The acute inhalation LC_{50}^2 value for rats is 0.81 ppm.
- ❑ Considered to be a moderate eye irritant. It may cause redness, swelling, and discharge, but is reversible.
- ❑ Considered to be a slight irritant to the skin.
- ❑ Slightly toxic dermally, through absorption. The acute dermal LD_{50} is greater than 2,000 mg/kg.
- ❑ Moderately toxic by ingestion. The oral LD_{50} is 498 mg/kg.³
- ❑ Comprised of only 8 percent active ingredient and 92 percent inert ingredients. (No other information is available regarding inert ingredients of this herbicide.)

4.5.2.1.2

Consumption of Contaminated Drinking Water

As discussed in Section 4.1, there are health risks associated with consumption of water treated with Komeen. The maximum contaminant level for copper is 1.3 ppm. Under the Two-Year Komeen Research Trials, Komeen would be applied to achieve a water column concentration of 0.75 to 1.0 ppm copper, which is only slightly below the enforceable limit for copper in drinking water.

However, Komeen Research Trial sites are not near any drinking water intake facilities. Thus, this would only be a potential impact if the location of the Research Trials were changed. Such a change would not occur without consultation with the appropriate regulatory agencies.

In conclusion, contamination of drinking water supplies by Komeen is an avoidable significant impact, and thus, related impacts to human health are also significant, but avoidable.

2 The Lethal Dose 50 or LD_{50} is the amount of a chemical that is lethal to one-half (50 percent) of the experimental animals exposed to it. LD_{50} s are usually expressed as the weight of the chemical per unit of body weight (mg/kg). It may be fed (oral LD_{50}), applied to the skin (dermal LD_{50}), or administered in the form of vapors (inhalation LD_{50}).

3 One milligram per kilogram (mg/kg) is equivalent to one part per million (ppm).

4.5.2.1.3 Consumption of Fish or Aquatic Organisms Exposed to Herbicides

As discussed in Section 4.2, the potential exists for bioaccumulation of Komeen to occur in tissues of fish and other aquatic organisms. Adverse impacts to human health could occur due to consumption of such fish. In conclusion, impacts to human health due to bioaccumulation of Komeen in tissues of fish and aquatic organisms would be an avoidable significant impact.

4.5.2.1.4 Swimming and Water Skiing

Product label information for Komeen indicates that areas treated with the herbicide may be used for swimming or other water recreation immediately following application. No adverse health impacts would result from in-water recreation in areas treated with Komeen at target concentrations. In conclusion, impacts to human health due to swimming or water skiing in water treated with Komeen would be less than significant.

4.5.2.1.5 Exposure to Concentrated Formulations of Komeen

Adverse impacts to health could occur to persons applying or handling Komeen if they ingested, inhaled or were sprayed by a concentrated formulation of the herbicide. Komeen is moderately toxic by ingestion, toxic if inhaled, and considered to be a moderate eye irritant. Adherence to herbicide handling procedures would minimize the possibility of this health risk. In conclusion, exposure to concentrated formulations of Komeen could result in avoidable significant impacts to human health.

4.5.2.2 Hazards to the Environment due to Catastrophic Herbicide Spill

A catastrophic spill of Komeen could result in adverse impacts to aquatic wetland and intertidal habitat and associated flora and fauna, including special status plants, fish and wildlife. Adverse impacts to human health could also occur due to exposure of concentrated herbicides following a catastrophic spill. Impacts could also occur to public water supplies, and agricultural production and operations. The degree of harm would depend on the amount of chemical spilled, environmental conditions (flow, tidal action) and emergency response time.

In conclusion, such a catastrophic spill of herbicides would be an avoidable significant impact.

4.5.3 Significance Determination for Hazards

The Two-Year Komeen Research Trials would result in the following unavoidable, avoidable and less than significant, impacts to Human Health listed below. For all avoidable impacts, mitigation measures are proposed to reduce the impact to a less than significant level.

4.5.3.1 Human Health

Unavoidable Significant Impacts

- ☐ None.

Avoidable Significant Impacts

- ☐ Avoidable significant impact to human health due to contamination of drinking water supplies with Komeen.
- ☐ Avoidable significant impact to human health due to bioaccumulation of Komeen in the tissues of fish and other aquatic organisms.
- ☐ Avoidable significant impact to human health due to exposure to concentrated formulation of Komeen.

Less Than Significant Impacts

- ☐ Less than significant impact to human health, due to swimming or water-skiing in water treated with Komeen. (Despite the fact that this is a less than significant impact, measures would be undertaken to notify the public regarding Research Trials. See mitigation measures below.)

4.5.3.2 Hazards to the Environment due to Catastrophic Herbicide Spill

Unavoidable Significant Impacts

- ☐ None.

Avoidable Significant Impacts

- ☐ Avoidable significant impact to aquatic and intertidal wetland habitat and associated flora and fauna, invertebrates, fish and wildlife; human health; drinking water supplies; and agricultural production and operations, due to potential catastrophic spill of Komeen.

Less than Significant Impacts

- ☐ None.

4.5.4 Mitigation for Impacts Related to Hazards

4.5.4.1 Human Health

Measures to Avoid Contamination of Drinking Water Supplies

- ❑ Agency Consultation - Consultation with the appropriate drinking water utilities, as well as the Department of Health Services, to determine when treatments would occur. Consultation would occur least two weeks prior to commencement of treatment.
- ❑ Buffer Zones - To avoid drinking water quality impacts (e.g., influx of copper, increase in trihalomethane formation potential, increase in turbidity), a one-mile buffer zone would be established around water treatment plant intakes. No Trials would occur within this buffer zone while utilities are drawing water. Research Trials within buffer zones would be coordinated with utilities. The DBW would coordinate with the appropriate public water agencies to establish buffer zones.

Minimization and avoidance measures for any herbicide treatments that is to occur within a certain number of miles of a public water intake (distance as yet to be determined) would involve the following:

- ❑ Pre- and Post-Treatment Sampling - If required by regulatory agencies or appropriate utilities, the DBW would conduct pre- and post-treatment sampling for biochemical oxygen demand (BOD), total organic carbon (TOC), dissolved organic carbon (DOC), and UVA-254. This sampling would be in addition to standard pre- and post-treatment sampling for DO, herbicide residue, turbidity, etc. These sampling efforts would be carefully coordinated with the appropriate public water agencies. Data would be shared with interested agencies. If any of these measurements exceeded Drinking Water Standards prior to a scheduled treatment, the treatments would be postponed until conditions were such that drinking water quality would not be compromised by Komeen Research Trial activities. If post-treatment sampling indicated violations of any standards, changes to the Trial protocol would be made to avoid future impacts.

Measure to Avoid and Minimize Public Exposure to Herbicide-Treated Water

Prior to Research Trials, marina and dock owners would be notified regarding timing of treatments. During herbicide treatments, sites would be marked with buoys, making trials more visible to the general public. Additionally, DBW staff would trawl trial areas on a support boat, informing recreators that Research Trials are occurring.

*Measures to Avoid and Minimize Public Consumption of
Contaminated Fish and other Aquatic Organisms*

Komeen Research Trial Sites would be closed to fishing and clamming for 48 hours following herbicide application.

*Measures to Avoid and Minimize Exposure to Concentrated
Formulation of Herbicides*

- ❑ To avoid impacts to human health due to exposure to concentrated formulations of Reward, all personnel involved with the application of Komeen would be trained in herbicide handling in accordance with the Food and Agriculture Code and Title 3 Code of Regulations Pertaining to Pesticides and Pest Control Operations. Participants would learn about herbicide toxicity, use of product labels and material safety data sheets (MSDS), proper handling of herbicides, emergency and first aid procedures in case of a spill, and the proper clothing and eye protection.

All aspect of the "Herbicide Handling Procedures and Spill Contingency Plan" would be followed. These documents are contained in **Appendix S**.

4.5.4.2

Hazards to the Environment due to Catastrophic Herbicide Spill

*Measures to Avoid and Minimize Exposure to Concentrated
Formulation of Herbicides*

- ❑ To avoid impacts to human health due to exposure to concentrated formulations of Komeen, all personnel involved with the application of these herbicides would be trained in herbicide handling in accordance with the Food and Agriculture Code and Title 3 Code of Regulations Pertaining to Pesticides and Pest Control Operations. Participants would learn about herbicide toxicity, use of product labels and material safety data sheets (MSDS), proper handling of herbicides, emergency and first aid procedures in case of a spill, and the proper clothing and eye protection.

All aspect of the "Herbicide Handling Procedures and Spill Contingency Plan" would be followed. These documents are contained in **Appendix S**.

4.6 Transportation and Traffic

This section assesses impacts of the Two-Year Komeen Research Trials to transportation and traffic in the Delta. Baseline conditions on transportation and traffic are presented in Section 2.6 of Chapter 2.

The impacts analysis includes consideration of the issues identified within the Environmental Checklist Form (contained as Appendix I in the CEQA Guidelines), which lists the following potential concerns relating to transportation problems: would the proposal result in:

- a) Increased vehicle trips or traffic congestion;
- b) Hazards to safety from design features (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment);
- c) Inadequate emergency access or access to nearby uses;
- d) Insufficient parking capacity on-site or off-site;
- e) Hazards or barriers for pedestrians or bicyclists;
- f) Conflicts with adopted policies supporting alternative transportation (e.g., bus turnout, bicycle racks); or
- g) Rail, waterborne or air traffic impacts.

This subsection focuses only on navigation and roadway travel within the project area. These two modes of transportation would be the only ones affected by Two-Year Komeen Trials. Other types of transportation, such as railway, aviation, bicycle, and pedestrian would not be affected by the Two-Year Komeen Trials.

4.6.1 Transportation Significance Threshold

Objective criteria for determining the significance of transportation impacts related to the proposed project were defined based on guidance from the CEQA Guidelines, Appendices G and I. Pursuant to Appendix G, a project will normally have a significant effect on the environment if it will:

- ☐ Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system; and
- ☐ Interfere with emergency response plans or emergency evacuation plans.

4.6.2 Environmental Impacts and Consequences on Transportation

A review of the proposed project activities revealed that the Two-Year Komeen Trials likely would have localized, short-term impacts to navigation and traffic in the immediate area of the Two-Year Komeen Trials. Navigation conditions are typically related to the presence or absence of obstacles that impede or prevent travel on area waterways. Similarly, traffic conditions are typically associated with obstacles that impede or prevent vehicle travel on area roadways. Therefore, it is anticipated that direct operational effects of the project likely would be limited to short-term effects that the Komeen Trials might have upon localized navigation and transportation. Project transportation impacts are typically construction-related, and since this project does not include any construction activities it is not expected to directly generate boat or vehicle traffic.

Impacts to Roadways

Herbicide application efforts would require one or two field vehicles carrying support staff to travel on public and private roads and atop levee crowns to bring personnel to treatment sites. These vehicles would be small enough in size and number to not pose any impacts to transportation in the area. Although, in locations where business, recreational, or agricultural activities are present, the DBW would modify or temporarily suspend Trial activities to minimize or avoid transportation impacts in these areas. Pre- and post-treatment monitoring of herbicide application would also require the short-term presence of one or two field vehicles, but these vehicles should pose no impacts to transportation in the immediate area. Prior to initiating the Trials, the DBW would gain necessary right-of-way clearances to levees and properties traveled upon in order to carry out program actions. Overall, short-term, localized impacts to roadway travel as a result of the Two-Year Komeen Trials likely would have a less than significant effect on transportation in the project area.

Impacts to Navigation

Two-Year Komeen Trials would involve operation of two boats: a herbicide spray boat and field personnel transport craft. Herbicide treatments are expected to take from 4 to 8 hours to apply, depending on acreage. During applications, navigation in and adjacent to treatment sites would be limited to DBW craft. In locations where Two-Year Komeen Trials completely obstructed a waterway and no alternate route of travel was available for affected boaters, the DBW would temporarily suspend Two-Year Komeen Trials to allow passage of boats.

Pre- and post-treatment monitoring activities also would require short-term presence of boats at or near treatment sites, but these craft should pose no impacts to navigation. Overall, short-term, localized navigational impacts from herbicide application likely would have a less than significant effect on transportation in the project area.

Boat traffic in the Delta is not expected to increase substantially due to improvement in navigation that may result from the Komeen Trials. While boater access to and from various locations may improve, the number of boats using the Delta is not expected to increase. One basis for this assumption is that a only a small number of surface acres (150) would be treated each year. Overall, the Komeen Trials may improve boat traffic in the Delta somewhat, by opening up channels for navigation. In conclusion, the Komeen Trials would result in less than significant impacts to transportation and traffic.

4.6.3

Significance Determination for Transportation and Traffic

Unavoidable Significant Impacts

- ☐ None.

Avoidable Significant Impacts

- ☐ None.

Less than Significant Impacts

- ☐ Less than significant impacts to transportation and traffic due to the Two-Year Komeen Research Trials.

4.7 Recreation

This section assesses impacts of the Two-Year Komeen Trials to recreational facilities or existing recreational opportunities. Baseline information on recreation and recreational facilities in the Delta is presented in Section 2.7 of Chapter 2.

According to the CEQA Guidelines, a project could significantly impact recreation if it would:

- ❑ Increase the demand for neighborhood or regional parks or other recreational facilities; or
- ❑ Affect existing recreational opportunities.

Impacts to recreation associated with EDCP activities should be limited to water-dependent recreational resources, therefore impacts to water-enhanced recreation will not be considered in this section.

4.7.1 Recreation Significance Threshold

Objective criteria for determining the significance of recreation impacts related to the proposed project were defined based on guidance from the CEQA Guidelines, Appendices G and I. Pursuant to Appendix G, "A project will normally have a significant effect on the environment if it will: (w) Conflict with established recreational, educational, religious, or scientific uses of the area." In addition, an impact is considered significant if implementing the proposed project would not support existing recreational goals and local planning policies.

4.7.2 Environmental Impacts/Consequences on Recreation

The Two-Year Komeen Trials likely would have localized, short-term, impacts on recreation in the immediate area of *Egeria* treatments. Water-dependent recreational activities such as boating, fishing, water skiing, and swimming could be temporarily limited, or precluded, for brief periods due to Two-Year Komeen Trials. Direct operational effects of the project likely would be limited to short-term effects that *Egeria* control treatments might have on localized recreational activities.

Herbicide applications would involve operation of two boats: a herbicide spray boat and field personnel transport craft. Herbicide treatments are expected to take from 4 to 8 hours to apply, depending on acreage. During applications, water-dependent recreational activities in and adjacent to treatment sites could be limited or prohibited by authority of DBW staff.

Overall, short-term, localized recreation impacts from herbicide application likely would have a less than significant effect on recreation in the project area. Potentially significant positive impacts on both water-dependent and water-enhanced recreation, stemming from a reduction in *Egeria* biomass in the project area, are possible.

4.7.3 Significance Determination for Recreation

Unavoidable Significant Impacts

- ☐ None.

Avoidable Significant Impacts

- ☐ None.

Less than Significant Impacts

- ☐ Less than significant impacts to recreation due to the Two-Year Komeen Research Trials.

4.8 Air Quality

This section assess impacts of the Two-Year Komeen Research Trials to air quality in the Delta. Air quality regulations and standards that apply to the Two-Year Komeen Trials are described. Impacts are analyzed by comparing these regulatory constraints to the air quality changes resulting from long-term operation of the Two-Year Komeen Trials. Baseline information on air quality is described in Section 2.8 of Chapter 2.

4.8.1 Air Quality Significance Threshold

Air pollutant emissions resulting from the EDCP would be significant if they exceeded any State or federal ambient air quality standards, or if they increased the severity of number of exceedences of ambient air quality standards.

An impact to air quality is significant, according to CEQA Guidelines, if it:

- ☐ Violates any air quality standard or contribute to an existing or projected air quality violation;
- ☐ Exposes sensitive receptors to pollutants;
- ☐ Alters air movement, moisture, or temperature, or cause any change in climate; or
- ☐ Creates objectionable odors.

The San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) has a current policy of using a threshold of 10 tons of emissions per year per pollutant type, for reactive organic compounds (ROC), nitrogen oxides (NO_x), and fine particulate matter (PM₁₀) emissions in determining potentially significant air quality impacts of different proposed projects (under CEQA and NEPA). However, for determining the significance of CO, the SJVUAPCD uses the potential impacts of the project to create CO hot spots (that is, exceeding ambient CO standards at the local scale). An air quality impact also would be considered significant if it would "create objectionable odors" (CEQA Guidelines, Environmental Checklist Form provided prior to Chapter 1).

Determination of general air quality is based on compliance with federal and State emission standards established for specific benchmark pollutants. At the federal level, the National Ambient Air Quality Standards (NAAQS) set emission limits for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, and suspended particulate matter. California also has set emission standards for the pollutants identified by the NAAQS, when it adopted the California Ambient Air Quality Standards (CAAQS). In addition to the

pollutants identified in the NAAQS, the CAAQS sets emission limits for sulfates, hydrogen sulfide, and visibility.

If a pollutant concentration exceeds any of these NAAQS or CAAQS standards in a basin or subregions of a basin, then that area is designated "non-attainment" for that pollutant. The NAAQS generally can be exceeded no more than once per year for short-term standards and not at all for annual standards. The CAAQS are not to be equaled or exceeded for either short-term or annual standards. Both the federal and State Clean Air Acts require basins that do not meet those standards to prepare a plan for bringing the area into compliance. The EDCP project area is located within three neighboring air basins: Sacramento Valley, San Francisco Bay Area, and San Joaquin Valley.

Sensitive Receptors

Sensitive populations (i.e., sensitive receptors) are more susceptible than the general population to the effects of air pollution. The San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) Rule 4103 defines sensitive receptors as: schools, day care facilities, hospitals, health care facilities, convalescent homes, senior residence facilities, or those otherwise specified by the SJVUAPCD. Sensitive receptors close to localized sources of toxics and CO are of particular concern. For purposes of impact assessment, sensitive receptors are expanded to include residences, playgrounds, rehabilitation centers, and athletic facilities.

Residences are the only sensitive receptors located near proposed EDCP control areas. The EDCP project area is generally rural agricultural land with very minor residential development. Most residences in the project area are isolated, single family dwellings, often associated with agricultural operations. Discovery Bay, Bethal Island, Hotchkiss Tract/Sandmound Slough, and Fourteenmile Slough represent the only localities in the project area with low to moderate residential development.

4.8.2

Environmental Impacts /Consequences on Air Quality

The proposed Two-Year Komeen Trials include short-term operation of boats, associated equipment, and field support vehicles. Localized, short-term air emissions from a small number of gas and diesel powered engines associated with the above equipment are not anticipated to significantly impact long-term air quality in the project area. Due to the limited number of personnel required for Two-Year Komeen Trials activities, the trials would not contribute significantly to the number of vehicles in the project area.

Komeen Application

Application Komeen would involve the operation of two boats: a herbicide spray boat, and field personnel transport craft. Additionally, one or two field vehicles carrying support staff would travel on public and private roads and atop levee crowns to bring personnel to the site. Pre- and post-treatment monitoring activities also would require short-term presence of boats and field vehicles at sites.

Two-Year Komeen Trials boat and vehicle operations are not anticipated to significantly alter ambient air quality conditions in the project area. Trial operations likely will contribute far fewer emissions/pollutants to the project area than local agricultural operations, and existing boat and roadway traffic. Trial activities would occur during daytime working hours to minimize potential exposure of sensitive receptors (i.e., local residents) to pollutants.

Overall Impacts of the Komeen Research Trials on Air Quality

Air quality is not expected to be adversely affected by improved navigational opportunities that may result from the Komeen Trials. While boater access to and from various locations may improve, the number of boats using the Delta is not expected to increase. Thus, the total quantity of exhaust expelled from motor boats each year is not expected to increase as a result of the Trials. The Trials could potentially result in a small net improvement in air quality, since any improvements to navigation would alleviate the need for boaters to detour around beds of *Egeria*. In conclusion, the Two-Year Komeen Research Trials would result in less than significant impacts to air quality.

4.8.3 Significance Determination for Air Quality

Unavoidable Significant Impacts

- ☐ None.

Avoidable Significant Impacts

- ☐ None.

Less than Significant Impacts

- ☐ Less than significant impacts to air quality due to the Two-Year Komeen Research Trials.

4.9

Mineral Resources

This section assess impacts of the Two-Year Komeen Trials to mineral resources of the Delta. Baseline information on mineral resources is described in Section 2.9 of Chapter 2.

CEQA requires that an EIR evaluate the energy requirements and conservation potential of proposed projects (CEQA Guidelines Appendix F). The CEQA Checklist Form asks would the proposal:

- a) Conflict with adopted energy conservation plans;
- b) Use non-renewable resources in a wasteful and inefficient manner; or
- c) Result in the loss of availability of a known mineral resource that would be of future value to the region and the residents of the State.

This discussion focuses on use of gasoline to run boats and personal watercraft, and use of diesel fuel and electricity to operate pumps used to withdraw and convey water from one location to another.

4.9.1

Mineral Resources Significance Threshold

Objective criteria for determining the significance of energy impacts related to the proposed project were defined based on guidance from the CEQA Guidelines, Appendices F and G. Pursuant to Appendix G, a project will normally have a significant effect on the environment if it will:

- ☐ Encourage activities which result in the use of large amounts of fuel, water, or energy; and
- ☐ Use fuel, water, or energy in a wasteful manner.

4.9.2

Environmental Impacts/Consequences on Mineral Resources

Current Energy Use

The significant growth and spread of *Egeria densa* in the sloughs and channels of the Sacramento-San Joaquin Delta during the 1990s have produced various navigational impairments for boaters and other recreational users of Delta waterways. In a number of locations within the project area, *Egeria* infestations force boaters to detour around navigational hazards created by the weed. While it is impossible to quantify the collective increase in gasoline consumption by boaters who take alternate travel routes to avoid contact

with dense *Egeria* infestations, it is reasonable to believe that overall gasoline consumption in the project area has increased due to the heightened presence of the plant during the past decade. Additional energy resources are also expended when boat towing services are required to transport “stranded” watercraft that have become incapacitated (typically a fouled motor) due to contact with *Egeria* infestations.

Furthermore, dense stands of the submerged plant, in combination with floating plant fragments, have obstructed water diversion structures, such as agricultural and municipal water intakes and State Water Project and Central Valley Project pumping facilities, thus impeding water conveyance. The obstruction of small water diversion structures and pumps with *Egeria* fragments increases the consumption of diesel fuel and electricity used to operate these pumps. Decreased flows through these structures require increased pumping, and thus increased energy consumption, in order to convey needed water supplies. A similar situation occurs at State and federal water pumping facilities. However, partial or total suspension of pumping operations at these facilities often leads to energy consumption conflicts with municipal users. Since most State and federal water pumping occurs “off peak” at night or on weekends, reduction or suspension of pumping caused by *Egeria* fragments requires these facilities to pump “on peak” to recover the water that was not able to be pumped off peak. This on peak pumping occurs when municipal electricity demand and consumption are at their highest.

Energy Demand Impact

Two-Year Komeen Trial activities are not expected to use non-renewable resources in a wasteful and inefficient manner. In fact, long-term project activities may lead to a decrease in energy consumption by boaters and water diverters in the project area due to a reduction in abundance of *Egeria*.

Short-term operation of boats, associated equipment, and field support vehicles during Two-Year Komeen Trial activities would not result in either the consumption of large amounts of fuel, water, or energy, or the wasteful use of these resources. Overall, Two-Year Komeen Trial activities likely would have a less than significant impact on energy resources in the project area.

4.9.3 Significance Determination for Mineral Resources

Unavoidable Significant Impacts

- ❑ None.

Avoidable Significant Impacts

- ❑ None.

Less than Significant Impacts

- ❑ Less than significant impacts to mineral resources due to the Two-Year Komeen Research Trials.

4.10 Noise

This section assess the impacts of the Two-Year Komeen Trial to noise levels in the Delta. Baseline information on existing noise levels in the Delta are presented in Section 2.10 of Chapter 2.

According to the CEQA Guidelines, a project may significantly impact noise levels if it:

- ❑ Increases existing noise levels, and
- ❑ Exposes people to severe noise levels.

4.10.1 Noise Significance Criteria

The criteria used to determine whether identified impacts are significant and adverse were developed through a review of CEQA Guidelines. Noise levels resulting from the Two-Year Komeen Trials would be significant if they would increase existing noise levels or expose people to severe noise levels. Pursuant to Appendix G of the CEQA Guidelines, “A project will normally have a significant effect on the environment if it will increase substantially the ambient noise levels for adjoining areas.”

4.10.2 Environmental Impacts/Consequences on Noise

Two-Year Komeen Trials are not expected to produce any long-term increases in existing noise levels. However, certain project activities may result in temporary elevated noise levels that could affect residents in the vicinity. These issues are discussed in the following sections.

Komeen Application

Application of herbicides to *Egeria* sites would involve the operation of two boats: a herbicide spray boat and field personnel transport craft. Additionally, one or two field vehicles carrying support staff would travel on public and private roads and atop levee crowns in order to bring personnel to the treatment site. Pre- and post-treatment monitoring activities also would require short-term presence of boats and field vehicles at treatment sites. Project-related boat and vehicle traffic would not create significant increases in noise levels beyond the ambient noise levels produced by local agricultural operations, and existing boat and roadway traffic. Also, Two-Year Komeen Trials would occur during daytime working hours to minimize potential disturbances to any adjacent residents. In conclusion, adverse noise impacts associated with herbicide applications would be less than significant.

4.10.3 Significance Determination for Noise

Unavoidable Significant Impacts

- ☐ None.

Avoidable Significant Impacts

- ☐ None.

Less than Significant Impacts

- ☐ Less than significant impacts to noise levels due to the Two-Year Komeen Research Trials.

4.11 Geology and Soils

This section assess impacts of the Two-Year Komeen Trials to geological and soil conditions in the Delta. Baseline information on geology and soils is presented in Section 2.11 of Chapter 2.

The CEQA Guidelines indicate that a project may significantly impact geology and soils if it would result in or expose people to potential impacts involving:

- a) Fault rupture
- b) Seismic ground shaking
- c) Seismic ground failure, including liquefaction
- d) Seiche, tsunami, or volcanic hazard
- e) Landslides or mudflows
- f) Erosion, changes in topography or unstable soil conditions from excavation, grading, or fill
- g) Subsidence of the land
- h) Expansive soils
- i) Unique geologic or physical features.

4.11.1 Geology Significance Threshold

Objective criteria for determining the significance of geologic impacts related to the proposed project were defined based on guidance from the CEQA Guidelines, Appendices G and I. Pursuant to Appendix G of the CEQA Guidelines, A project will normally have a significant effect on the environment if it will:

- ☐ Cause substantial flooding, erosion, or siltation, and
- ☐ Expose people or structures to major geologic hazards.

4.11.2 Environmental Impacts and Consequences on Geology

The Two-Year Komeen Trials does not include grading or excavation of geologic materials, or construction of any facilities that could be affected by seismic activity. Project activities would not expose people to potential impacts involving fault rupture, seismic disturbance, landslides or mudflows, subsidence, or expansive soils. In conclusion, soil erosion and disturbance impacts associated with Two-Year Komeen Trials would be less than significant.

4.11.3 Significance Determination for Geology and soils

Unavoidable Significant Impacts

- ❑ None.

Avoidable Significant Impacts

- ❑ None.

Less than Significant Impacts

- ❑ Less than significant impacts to geology and soils due to the Two-Year Komeen Research Trials.

4.12**Land Use and Planning**

The following briefly discusses the basis for the conclusion that the Two-Year Komeen Research Trials would not impact land use and planning in the Delta. Baseline information on land use and planning is presented in Section 2.12 of Chapter 2.

According to the CEQA Checklist, a project may significantly impact land use and planning if it:

- ☐ Physically divided an established community;
- ☐ Conflicted with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project adopted for the purpose of avoiding or mitigation an environmental effect; or
- ☐ Conflicted with any applicable habitat conservation plan or natural community conservation plan.

The Komeen Trials would not result in any of these impacts. Project activities would not divide any established communities, nor would they conflict with any land use plans, policies or regulations. (The project would result in avoidable impacts to agricultural resources, however these impacts are discussed under Agricultural Resources, Section 4.3.) There are no applicable habitat conservation plans or natural community conservation plans in the project area. (Project related impacts to habitat would occur, however these are discussed under Biological Resources, Section 4.2.) In conclusion, the Two-Year Komeen Research Trials would not impact land use and planning in the Delta.

4.13

Public Services

The following briefly discusses the basis for the conclusion that the Two-Year Komeen Research Trials would not impact public services in the Delta. Baseline information on public services in the Delta is presented in Section 2.13 of Chapter 2.

According to the CEQA Checklist, a project may significantly impact public services if it:

- ❑ Resulted in the need for new or physically altered government facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for public services, such as fire protection, police protection, schools, parks, other public facilities.

The Komeen Trials would not result in the need for new or altered public service facilities, since no significant increases in the resident population or number of people utilizing the Delta are expected to occur as a result of the Trials. In conclusion, the Two-Year Komeen Research Trials would not impact public services in the Delta.

4.14 Population and Housing

The following briefly discusses the basis for the conclusion that the Two-Year Komeen Research Trials would not impact population and housing in the Delta. Baseline information on population and housing is presented in Section 2.14 of Chapter 2.

According to the CEQA Checklist, a project may significantly impact population and housing if it:

- ❑ Induced substantial population growth in an area, either directly or indirectly;
- ❑ Displaced substantial numbers of existing houses, necessitating the construction of replacement housing elsewhere; or
- ❑ Displaced substantial numbers of people, necessitating the construction of replacement housing elsewhere.

No significant increases in population growth are anticipated as a result of improvements to navigational opportunities in the Delta brought about by the Komeen Trials. Improved navigation may increase use of certain businesses that occur along the channels of the Delta. This in turn could result in a small increase in local population, although this statement is purely speculative. However, the scope of the Trials (treatment of approximately 300 acres per year) is so small, that increases in population would be less than significant. In conclusion, the Two-Year Komeen Research Trials would not impact population and housing.

4.15

Cultural Resources

The following briefly discusses the basis for the conclusion that the Two-Year Komeen Research Trials would not impact cultural resources in the Delta. Baseline information on cultural resources is presented in Section 2.15 of Chapter 2.

According to the CEQA Checklist, a project may significantly impact cultural resources if it:

- ❑ Caused a substantial adverse change in the significance of a historical resource;
- ❑ Caused a substantial change in the significance of an archaeological resource;
- ❑ Directly or indirectly destroyed a unique paleontological resource or site or unique geologic feature; or
- ❑ Disturbed any human remains, including those interred outside of formal cemeteries.

The Komeen Trials would not occur in the vicinity of any historical, archaeological, or paleontological resources, unique geologic features, or areas where human remain may be interred. Further, project activities are focused in channels and sloughs, and thus would not result in disturbances to land or soils where such resources or remains may occur. In conclusion, the Two-Year Komeen Research Trials would not impact cultural resources.

4.16

Aesthetics

The following briefly discusses the basis for the conclusion that the Two-Year Komeen Research Trials would not impact aesthetics of the Delta. Baseline information on aesthetics is presented in Section 2.16 of Chapter 2.

According to the CEQA Checklist, a project may significantly impact aesthetics if it:

- ❑ Had a substantial adverse effect on a scenic vista;
- ❑ Substantially damaged scenic resources, including but not limited to trees, rock outcroppings, and historic buildings within a state scenic highway;
- ❑ Substantially degraded the existing visual character or quality of the site or its surroundings; or
- ❑ Created a new source of substantial light or glare, which would adversely affect day or nighttime views in the area.

The Komeen Trials would not impact scenic views or resources, or create a new source of light or glare, since project operations would be focused on the water column. (Control of *Egeria* may be considered to improve the existing visual quality of various sites in the Delta.) In conclusion, the Two-Year Komeen Research Trials would not impact aesthetics of the Delta.